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Flood Control, Power, and Water Resource Development, Colorado and Muddy Rivers, Las Vegas Wash, Nev.

HEARINGS

BEFORE A

SUBCOMMITTEE OF THE COMMITTEE ON PUBLIC WORKS UNITED STATES SENATE

EIGHTY-SECOND CONGRESS

SECOND SESSION

ON

PROPOSALS FOR WATER RESOURCE DEVELOPMENT ON THE COLORADO AND MUDDY RIVERS, LAS VEGAS WASH, AND ELECTRIC POWER IN THE STATE OF NEVADA

OCTOBER 10, 11, 13, AND 20, 1952

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FLOOD CONTROL, POWER, AND WATER RESOURCE DEVELOPMENT, COLORADO AND MUDDY RIVERS, LAS VEGAS WASH, NEV.

FRIDAY, OCTOBER 10, 1952

UNITED STATES SENATE,
SUBCOMMITTEE ON FLOOD CONTROL, RIVERS AND HARBORS OF THE COMMITTEE ON PUBLIC WORKS,
Henderson, Nev.

The subcommittee met at 9:30 a. m. in the Victory Theater at Henderson, Nev., Senator George W. Malone presiding.

Present: Senator Malone.

Senator MALONE. The notice of this hearing has been published in various newspapers in Nevada. I would like to read the notice that was sent out from the Public Works Committee in Washington, and include in the record a list of persons and organizations to whom invitations to attend were sent.

[Telegram]

WASHINGTON, D. C., *September 23, 1952.*

Senator GEORGE W. MALONE,
Title Insurance Building, Reno, Nev.:

Notification sent to all listed in your message as follows:

"Notice of public hearing flood control and water-resources development in Nevada.

"A subcommittee of the Committee on Public Works, United States Senate, will hold a public hearing at Henderson, Nev., in the Henderson Theater Building at 9 a. m., Friday, October 10, continuing until all witnesses are heard. The hearing will be for the purpose of receiving and considering information concerning the needs for flood control in southern Nevada, for additional hydroelectric power, and for water supplies. The following subjects will be considered at this hearing: Bridge Canyon Dam on the Colorado River in accordance with provisions of Senate bill 3487; investigations for flood control on Las Vegas Wash as authorized in Public Law 479; Muddy River storage for Moapa Valley, Clark County, Nev.; Pine Flat and Methews Reservoirs for flood control on Meadow Valley Wash and lower Muddy River; coordination of hydroelectric power development at Hoover Dam, Davis Dam, the proposed Bridge Canyon Dam, and other proposed Federal installations; water-supply needs in the southern Nevada area.

"All studies and reports on these subjects will be reviewed and considered at this hearing. All interested parties are invited to be present or represented at the hearing. They will be given full opportunity to express their views on these subjects. Oral statements will be heard. It is suggested, however, that all important facts and arguments be submitted in writing in order to insure accuracy of the record, as a report of this hearing will be submitted to the Committee on Public Works of the United States Senate when the 83d Congress convenes."

E. W. BASSETT,
Technical Staff, Public Works Committee,
United States Senate.

INVITATIONS WERE SENT TO THE FOLLOWING ORGANIZATIONS TO ATTEND PUBLIC HEARING, HENDERSON, NEV., OCTOBER 10–11, 1952

Basic Magnesium Project Administration, Robert Julian Moore, manager, Henderson, Nev.
Burns, Col. D. S., division engineer, South Pacific division, San Francisco, Calif.
Clark County, County Commissioners, Las Vegas, Nev.
Colorado River Commission of California, Raymond Mathews, chief engineer, 314 South Broadway, Los Angeles, Calif.
Colorado River Commission of Nevada, Gov. Charles H. Russell, chairman, Carson City, Nev.
Colorado River Water Users Association, A. J. Shaver, director, Henderson, Nev.
Combined Metals Reduction Co., E. H. Snyder, president, Felt Building, Salt Lake City, Utah.
Department of Defense, Munitions Board, John D. Small, Chairman, The Pentagon, Washington, D. C.
Federal Power Commission, Custom House, San Francisco, Calif.
Henderson Chamber of Commerce, Henderson, Nev.
Imperial Irrigation District, El Centro, Calif.
Las Vegas Chamber of Commerce, Las Vegas, Nev.
Las Vegas City Council, Las Vegas, Nev.
Las Vegas Valley Water District, Las Vegas, Nev.
Lincoln County Power District, P. P. Hoover, Manager, Ely, Nev.
Manganese, Inc., F. S. McGonigle, manager, Henderson, Nev.
Mayor of Las Vegas, C. D. Baker, City Hall, 400 Stewart Street, Las Vegas, Nev.
Metropolitan Water District, Julian Hinds, general manager, 306 West Third Street, Los Angeles, Calif.
Muddy River Irrigation Co., Overton, Nev.
National Reclamation Association, William E. Welsh, secretary-manager, 1119 National Press Building, Washington, D. C.
Nevada State Board of Control, Gov. Charles H. Russell, chairman, Carson City, Nev.
Nevada State engineer, Hugh Shamburger, Carson City, Nev.
Nevada State Federation of Labor, Harry A. Depoali, president, 440 North Virginia Street, Reno, Nev.
Nevada State Federation of Labor, James H. Ryan, Secretary-Treasurer, 704 South Sixth Street, Las Vegas, Nev.
Nevada State Labor News, Paul E. Weaver, Sr., publisher, 323 Sierra Street, Reno, Nev.
Nevada State Planning Board, A. M. Mackenzie, 1374 Lander Street, Reno, Nev.
Nevada State Reclamation Association, Carl Gelmstedt, secretary, Yerington, Nev.
Overton Power District, Overton, Clark County, Nev.
Pittman Chamber of Commerce, Pittman, Clark County, Nev.
Secretary of the Air Force, Hon. Thomas K. Finletter, the Pentagon, Washington, D. C.
Secretary of the Army, Hon. Frank Pace, Jr., the Pentagon, Washington, D. C.
Secretary of the Navy, Hon. Dan A. Kimball, the Pentagon, Washington, D. C.
Soil Conservation Service, George Hardman, director, University of Nevada, Reno, Nev.
Stauffer Chemical Co., Art Newell, general manager, Henderson, Nev.
Titanium Metals Corp. of America, Rollin Smith, general manager, Henderson, Nev.
United States Bureau of Reclamation, Interior Building, Washington, D. C.
United States Bureau of Reclamation, Region No. 3, E. G. Neilsen, Boulder City, Nev.
United States Corps of Engineers, district engineer Los Angeles division, Los Angeles, Calif.
Las Vegas Water Co., Al Folger, general manager, Las Vegas, Nev.
Los Angeles Department of Water, Light, and Power, Samuel B. Morris, general manager, 207 South Broadway, Los Angeles, Calif.
United States Indian Service, 751 South Figurero Street, Los Angeles, Calif.
United States Geological Survey, Interior Building, Washington, D. C.
United States Geological Survey, Groundwater Division, Carl Paulsen, Chief, Interior Building, Washington. D. C.
United States General Services Administration, Jess Larson, Administrator, General Services Building, Washington, D. C.

Western Electro Chemical Co., Fred Gibson, general manager, Henderson, Nev.
White Pine Power District, P. P. Hoover, manager, Ely, Nev.
Upper Colorado River Commission, J. G. Will, secretary-general counsel, 520 Rood Avenue, Grand Junction, Colo.
Arizona Power Authority, K. S. Wingfield, administrator, Phoenix, Ariz.
Palo Verde Irrigation District, Palo Verde, Calif.

ADDITIONAL INVITATIONS SENT TO THE FOLLOWING COMPANIES (SEPTEMBER 29, 1952)

Beech Aircraft Corp., East Central Avenue, Wichita, Kans.
Bell Aircraft Corp., Post Office Box 1, Buffalo, N. Y.
Boeing Airplane Co., Box 3107, Seattle 14, Wash.
Cessna Aircraft Corp., 501 Fifth Avenue, New York, N. Y.
Chance Vought Aircraft Corp., Post Office Box 5907, Dallas, Tex.
Chase Aircraft Co., West Trenton, N. J.
Consolidated Vultee Aircraft Corp., 3165 Pacific Highway, San Diego 12, Calif.
Douglas Aircraft Co., Inc., 3000 Ocean Park Boulevard, Santa Monica, Calif.
Fairchild Aircraft Division, Hagerstown, Md.
Goodyear Aircraft Corp., 1210 Massillon Road, Akron, Ohio
Grumman Aircraft Engineering Corp., Bethpage, Long Island, N. Y.
Hughes Aircraft Co., Florence Avenue at Teale Street, Culver City, Calif.
Kaiser-Frazer Corp., Willow Run, Mich.
Lockheed Aircraft Corp., 2555 North Hollywood Way, Burbank, Calif.
Glenn L. Martin Co., Middle River, Md.
Northrup Aircraft, Inc., Northrop Field, Hawthorne, Calif.
North American Aviation, Inc., Los Angeles International Airport, Los Angeles 45, Calif.
Piper Aircraft Corp., Lock Haven, Pa.
Pratt & Whitney Aircraft Division of United Aircraft Corp., East Hartford, Conn.
Republic Aviation Corp., Conklin Street, Farmingdale, Long Island, N. Y.
Sperry Gyroscope Co., Great Neck, Long Island, N. Y.

The great need for this area and for the entire Southwest has been for more reasonably priced power. It might be called low-cost power, but some industries require lower-cost power than others to be feasible and perhaps the power rate would range all the way from 2 mills a kilowatt-hour, for the Boulder, now Hoover Dam power at the switchboard to perhaps a half a cent or more for other sources. But in order for certain industries in the Southwest for national defense and other purposes, to make the investment required for their industry, the committee realizes that they must have advance information and certain assurances of available power and know the possible cost before they make their initial investment, which, of course, is necessary before production can be stepped up. Power is needed in this area for the manufacture of titanium, for jet plane fuel, chlorine, caustic soda, and many other products that enter into the manufacture of products essential to national defense. Of course, the local people need to know, meaning by local, the people in Henderson, Boulder City, Las Vegas, North Las Vegas, need to know the possible source of power on a domestic basis as to what they might expect. Naturally, there is some help to be expected in the natural gas source that may be available to this area within a reasonable time. Nevada has exhausted all the hydroelectric power that she will have for many years. Of course, we have this possibility of a development of commercial power from nuclear energy, atomic energy. It may arrive in time to help.

As a matter of fact the Atomic Energy Commission is considering a plant now in the Eureka area in central Nevada, and is investigating that site among others. The economics seem to run with the Eureka site because of the high cost of power there from fuel sources as compared to the power that might be generated by the atomic energy. It

would be, according to the Atomic Energy Commission, somewhat in the nature of a pilot plant, but with 20,000 to 30,000 kilowatts capacity. They think power can be produced for a price of a cent and a half per kilowatt-hour, which would be high cost for this Henderson area but low cost for central Nevada where no hydroelectric power is available, or any low-cost fuel. There is such a plant at Arco, Idaho, a very small plant, however, 250 kilowatts. But through very small plants the practicability of nuclear energy as a source of power has been proven. The thing that yet remains to be determined is the cost. The cost of power in the Eureka area is about 3 cents per kilowatt-hour from the high-cost fuel that is necessary to use in that area. It would mean they could save a cent and three-quarters per kilowatt-hour for the mines and water company and the various other users in that area and still sell it at a cent and a quarter, which is estimated would make a slight profit for the Government. Whereas in any area where low-cost fuel exists, where there may be from 4 to 4½ mills per kilowatt-hour for power generated through steam, using the low-cost power would lose maybe three-quarters of a cent per kilowatt-hour. So, the economics run with the Eureka site and we hope that the plant may be located there and will be built in the near future and eventually be coordinated with the use of other power in southern Nevada and the entire Southwest. Of course, we have our Hoover Dam, Boulder Dam power with its approximately 700,000 horsepower which has been allocated. The States of Arizona and Nevada have been allocated 36 percent of the firm power from this source, but our part of that power is all in use. Then the Davis Dam has been constructed and one-fourth of that energy has been allocated to our State and that power is all in use or contracted for. We know, too, that the same source of power is practically exhausted in other areas. Our Colorado River Commission has applied for one-third of the power to be developed at the Bridge Canyon site and our part of that, roughly, would amount to 200,000 or 250,000 kilowatts because the entire installation would amount to, perhaps, 700,000 kilowatts, all these figures to be corrected by future witnesses. Then the Bridge Canyon Dam for which I have introduced a bill in the United States Senate, would store approximately 3 million acre-feet of water and generate approximately 700,000 kilowatts of power. For the benefit of those who are not familiar with power, 100 percent load factor in kilowatts equals 8,760 kilowatt-hours.

This bill I have introduced is S. 3487 and it is simply introduced to construct a dam at this site for power purposes realizing full well in order to make full use of this site, Glen Canyon above Bridge Canyon must be also constructed. I understand, and we will have witnesses to establish the capacity of their reservoir and the power to be generated, but 26 million acre-feet is approximately the capacity of the Glen Canyon Reservoir, proposed reservoir and approximately 800,000 kilowatts of installed plant capacity would be available there. Our Davis Dam power adds up to 45,000 kilowatts and together with the construction of the Bridge and Glen Canyon Dams in the years ahead, all of that power available to the Southwest, perhaps some for Utah and New Mexico, but certainly to Arizona, Nevada, and California, the entire Southwest. Now we have a contract already signed between the Colorado River Commission and the Secretary of the Interior

for 33,000 kilowatts of Shasta Dam power in the Central Valley project of California, 30,000 of which has been earmarked by the Commission to be utilized in this area. Understand, of course, through a transfer of power, perhaps Shasta power, very little if any would reach this area, but through a wheeling and transfer contract at least that amoun of Boulder power would remain here and an equal amount of Shasta power would be used in the area where Hoover Dam power is now utilized in southern California. The precedent has been set, and since the precedent has been set by the contract for Shasta power, perhaps more of that power can be secured if national defense needs justify it for this area as other power dams are completed and come into use in the Central Valley of California—Folsom Dam perhaps in 1954, with 170,000 kilowatts. A reasonable amount of that power, at least 50 or 60 thousand kilowatts might be available, at least it is in the cards. Then there will be further dams on the Feather River and the Trinity River. It will be perhaps 25 years in the future before all of these sites are developed. Now in addition to the power setup, which the committee considers very important at this time due to the national defense needs and the threat of further trouble throughout the world, we have a flood control problem. Naturally, the silt control on the Colorado River as far as the Lake Mead is concerned would be partially solved by the construction of these reservoirs higher up stream, at Glen Canyon and Bridge Canyon. Then on the Muddy River we already have had authorized the construction of Pine Canyon and Mathews Canyon Dams, both flood-control dams on the upper Muddy. Congress has also authorized the Army engineers to make a survey to determine the cost of flood control on the Muddy Valley waters, near Las Vegas. That will be completed in a reasonable length of time and we hope we can build the Pine Canyon and Mathews Canyon Reservoirs within a reasonable length of time.

The President has said that these projects cannot go ahead as long as we have a police action in Korea. We are hoping that a solution of that problem will be arrived at within a reasonable time. Especially we hope that the Muddy River flood control can be accomplished within a reasonable time because there is a continual threat to transportation in that area and the Union Pacific Railroad travels through that canyon there for many miles and has been put out of commission three or four times, 4 weeks at a time in years past. If we were to have a real emergency and something of that kind happened, it could be a national catastrophe. In summing up the need for a hearing at this time the committee is anxious to have this information in January when they convene, because if we wait until Congress convenes perhaps it would be April or May before Congress got well established and it would be possible for a subcommittee to hold these hearings. Whereas, if we start the hearings now, complete them within a reasonable time, the transcript can be ready for the committee in January so that the subcommittee can study the results of the hearing and report to the main committee without undue loss of time. As I have previously said, the Army, Navy, the Air Corps, the Air Service, represented by Mr. Finletter, has time and again emphasized the need for the many products that are produced in this area, but particular reference was made to titanium. Titanium, of course, uses

some other products that are produced here with this power. This hearing is necessary so that they can plan for the future and so that the Titanium Corp. and the other industries represented here may make their plans and make the necessary expenditures for plant expansions which is impossible without having reasonable assurance that the necessary power will be available when the plants are ready. I will now call the roll of the agencies that were notified, and the representatives here will please answer to their names.

E. G. Neilson, director of region III, Bureau of Reclamation, Boulder City, Nev.

Mr. E. G. NIELSON. Here Senator, and this is Mr. McPhail.

Senator MALONE. Mr. Nielson is present together with Mr. Harvey McPhail, Assistant Commissioner of Reclamation. And Mr. Nielson, what are his initials?

Mr. NIELSON. Harvey F. McPhail.

Senator MALONE. District engineer, United States Corps of Engineers, Los Angeles district, Los Angeles, Calif.

Colonel SHULER. Colonel Shuler, and with me are Mr. Thompson, chief of my engineering division, Mr. Spencer, civil engineer, from my office and here as an observer is Mr. Vonseggern from the South Pacific division engineers office.

Senator MALONE. Would you give your initials Colonel Shuler?

Colonel SHULER. W. R. Shuler.

Senator MALONE. And the initials of your associates.

Colonel SHULER. Harry W. Thompson, Raymond T. Spencer, and Otto C. Vonseggern.

Senator MALONE. Thank you. Julian Hinds, general manager, Metropolitan Water District, 305 West Third Street, Los Angeles, Calif. Who represents Mr. Hinds?

Mr. MULLERS. Senator, Mr. Hinds is not present, the district however, is represented by C. C. Elder.

Senator MALONE. And you are Dr. Mullers. Raymond Matthew, chief engineer of Colorado River Commission of California, San Francisco. Is Mr. Matthew here?

Mr. MATTHEW. Here, Senator.

Senator MALONE. Is Samuel B. Morris here?

Mr. MORRIS. Here, general manager of Los Angeles Department of Water and Power, and with me is W. S. Peterson, electrical engineer and assistant manager, and Ivan L. Bateman, chief engineer of the power division of the department of water and power, Mr. John H. Matthews, who is counsel for the department of water and power.

Senator MALONE. Don't you have another engineer here with you who represents the Imperial Valley?

Mr. DOWD. M. J. Dowd, consulting engineer of Imperial irrigation district.

Senator MALONE. Indian service, United States Indian Service, 751 South Figueroa Street, Los Angeles, Calif. Is the Indian service represented?

Mr. CRANE. Senator, I am C. J. Crane, Nevada Indian Agency. I am not sure that Mr. Parnell is here from the Colorado River or not.

Mr. PARNELL. I am Robert M. Parnell from Colorado River.

Senator MALONE. Mr. Parnell, you represent the Colorado River Commission?

Mr. PARNELL. No, the Colorado River Indian Department.

Senator MALONE. Now, the Colorado River Commission of Nevada, Gov. Charles H. Russell, chairman, Carson City, Nev. Is there a representative here of the Colorado River Commission?

Mr. NEUMANN. Senator, I am Clarence Neumann of Jim Shaver's office, Colorado River Commission.

Senator MALONE. E. H. Snyder, president, Combined Metals Reduction Co., Salt Lake City, Utah. Is there a representative here of the Combined Metals Co.? Rollin Smith, general manager of Titanium Metals Corp. of America, Henderson. Is there a representative from the Titanium Metals Corp.? I might say that I talked with representatives of these companies here and they are expected before noon. Western Electrochemical Co., Fred Gibson, general manager. Is there a representative of the Western Electrochemical Co. here? I am assured that there will be a representative here. Robert Julian Moore, manager of Basic Magnesium Project Administration, Henderson; Manganese Inc., F. S. McGonigle, manager, Henderson, Nev.

Mr. MCGONIGLE. Senator, I am F. S. McGonigle, general manager of Manganese, Inc.

Senator MALONE. Thank you. Stauffer Chemical Co., A. T. Newell, general manager Henderson, Nev.

Mr. MARTINDALE. Roy Martindale, consulting engineer, Stauffer Chemical Co.

Senator MALONE. The Las Vegas Chamber of Commerce. The Henderson Chamber of Commerce.

Mr. TRUMBO. Senator, I am H. R. Trumbo of the Henderson Chamber of Commerce.

Senator MALONE. The Pittman Chamber of Commerce. United States General Services Administration, Jess Larson, Administrator. Imperial Irrigation District, we already have Mike Dowd, of central California, engineer. The Federal Power Commission, San Francisco.

Mr. BELL. George R. Bell, electrical engineer representing the San Francisco regional office, Federal Power Commission.

Senator MALONE. United States Geological Survey, Interior Building, Washington, D. C.

Mr. ROBINSON. T. W. Robinson, representing the United States Geological Survey.

Mr. ODELL. Mr. Jack W. Odell, Geological Survey, Surface Water Branch, Salt Lake City, Utah.

Senator MALONE. Thank you. Carl Paulsen, Chief, Ground Water Division of United States Geological Survey, Interior Building, Washington, D. C.

Mr. ROBINSON. I am representing Mr. Paulsen.

Senator MALONE. Mr. Robinson is representing Mr. Paulsen. Thank you. The National Reclamation Association, William E. Welsh, secretary and manager, Washington, D. C. Is anyone representing Mr. Welsh? The Las Vegas Water Co., Al Folger, general manager. Las Vegas City Council, Las Vegas, Nev. Nevada State Planning Board, Larry McKenzie, secretary. C. D. Baker, mayor of Las Vegas. Las Vegas Valley water district. Lincoln County power district. White Pine power district, P. P. Hoover, manager, Ely. Overton power district, Overton, Clark County, Nev. Hugh Shamberger, Nevada State engineer.

Mr. SHAMBERGER. Present.

Senator MALONE. Thank you. Muddy River Irrigation Co., Overton. Thomas K. Finletter, Secretary of Air, Pentagon, Washington, D. C. Frank Pace, Jr., Secretary of the Army. Dan A. Kimball, Secretary of the Navy, Department of Defense.

Mr. CLARK. John A. Clark, District Public Works Office, Naval Department, San Francisco, representing Chief of the Bureau of Yards and Docks, in turn representing the Secretary of the Navy.

Senator MALONE. Sergeant Hartman, of Defense Munitions Board, John D. Small, Chairman. Nevada State Reclamation Association. Nevada State Board of Control, Governor Russell. George Hardman, Nevada conservationist, Soil Conservation Service.

A VOICE. He will be here later.

Senator MALONE. Yes, he indicated to me that he would. We will start the hearing by calling on Mr. Shuler. What is your rank, Mr. Shuler?

Colonel SHULER. Colonel.

Senator MALONE. Colonel Shuler, representing the United States Corps of Army Engineers, Los Angeles district. Would you come forward, Colonel Shuler?

Colonel SHULER. May I have this map put up here where everyone can see it? [Displays a map.]

Senator MALONE. Yes, Colonel. Will you please begin your testimony by outlining the status of the Bridge Canyon Reservoir and Dam and perhaps Glen Canyon or any combination that you see fit. You may proceed in your own way in describing the development of supplemental power on the Colorado River that might be available to the Southwest.

STATEMENT OF COL. W. R. SHULER, CORPS OF ENGINEERS, DISTRICT ENGINEER, LOS ANGELES DISTRICT

Colonel SHULER. Thank you, Senator. Along that line, since the flood-control aspects in that region are not of a primary nature, I don't believe I could have too much to say about the power development there, but rather that would be a matter under the jurisdiction of the Bureau of Reclamation. The thing that I have to cover today, according to the agenda, the portion of the agenda that we are concerned with so far as the primary responsibility of it goes, would be Pine and Mathews Canyon Dams. The Las Vegas Wash flood-control plans, and possibly something to say on White Narrows Dam.

Senator MALONE. I think that is true, but flood control as proposed in my bill to construct Bridge Canyon Dam should be discussed in a general way, I believe. This bill was assigned to the Public Works Committee, which is primarily the responsibility of our Army engineers. You may proceed.

Colonel SHULER. I am wondering if either one of our assistants has anything to say on that because I understood the construction on Bridge Canyon had to do with hydroelectric power development and the only statement that I have to make on that, and I would be very glad to make that now, is that all of the Colorado River projects mentioned in the agenda for consideration at this conference are Bureau of Reclamation projects that are principally for the development of power and conservation of water, with the exception of Hoover Dam. The Corp of Engineers is responsible for advising the Bureau in re-

gard to operation of flood-control features of Hoover Dam, the only one of the projects mentioned that provides definite storage space for flood control. The coordination of hydroelectric power development that the agenda mentioned for consideration does not come within the jurisdiction of the Corps of Engineers activities. That is the only statement I have to make on it Senator.

Senator MALONE. I think that is very clear and we do have the Bureau of Reclamation represented here. Mr. McPhail, Assistant Commissioner, is probably more familiar with the entire power problem than anyone else. We will hear from him in due time.

Colonel SHULER. All right, sir.

Senator MALONE. You may proceed with the projects that you are prepared to discuss.

Colonel SHULER. Is it all right to bring a little history into this?

Senator MALONE. I think it would be very helpful.

Colonel SHULER. I am sure some of you are familiar with some of this, but I think it should be in the record. The first project authorized for construction by the Corps of Engineers from Nevada was a result of a flood-control act approved June 28, 1938, No. 761, 75th Congress, which authorized the Corps of Engineers to make a preliminary examination survey of the Virgin River Basin of Nevada, Arizona, and Utah. A preliminary examination was prepared by the district engineer, Los Angeles district, made on July 15, 1939, and the Chief of Engineers on March 5, 1940, authorized the survey to determine the advisability and cost of improvements and the extent of local cooperation required. The survey report was prepared in accordance with this authorization and was submitted on June 20, 1942. The Board of Engineers for Rivers and Harbors, in its review of the report, requested additional studies in connection with the economic analysis of the effect of flood-control improvements on Meadow Valley Wash and the lower Muddy River. The Board also requested reconsideration of the study involving White Narrows Reservoir proposed on the Muddy River above Glendale, Nev. At that time the proposed project at White Narrows was under consideration by the Indian Service as a means of supplying irrigation water to the Moapa Indian Reservation. The project was also desired by agricultural interests in the vicinity of Overton in the lower Moapa Valley along the lower Muddy River between Glendale and Lake Mead.

The Bureau of Reclamation was also involved in making certain dam and reservoir site explorations. Before work could be resumed on the restudy of the report, as directed by the Board of Engineers of Rivers and Harbors, World War II intervened and limitations on funds and personnel prevented any substantial progress. Delay on the work of the report was influenced by the fact that in addition to the problems of flood control in the Muddy Valley Wash Basin, and the difficulty of coordinating the work on the White Narrows project, and several other agencies, all were affected by the war effort. Local interests desired consideration of approximately 80 other improvements at various other locations along the main Virgin River and its tributaries. These improvements involved principally storage for irrigation and water supply. After World War II it appeared that an interim report covering the matter of flood control in the upper basin of the Meadow Valley Wash might well be submitted in advance of

final conclusions for the remainder of the basin. In view of the fact that improvements in the remainder of the Virgin River Basin did not appear to involve major flood-control measures or other activities within the jurisdiction of the Corps of Engineers, and in view of the fact that full coordination and reconciliation of the views of the Federal agencies and local interests on the White Narrows project had not been achieved, it appeared advisable to prepare and submit the interim report so that action could be taken by Congress at an early date. The interim report on survey, flood control, Meadow Valley Wash and lower Muddy River in Nevada, was submitted by the district engineer November 15, 1948, and after reviews by the Board of Engineers for Rivers and Harbors, was approved by the Chief of Engineers September 12, 1949. The report is printed as House Document No. 530, 81st Congress. Flood-control dams at Pine Canyon and Mathews Canyon sites in the upper Meadow Valley Wash Basin, as you can see by the black arrows on the chart, as recommended in the report of the Corps of Engineers, were authorized in the flood control act approved May 17, 1950. Work on completion of the comprehensive report on the Virgin River, including further consideration of White Narrows project and the eighty-odd storage and channelization projects in the main Virgin River Valley Basin was not expedited because of that large backlog of reports in the years immediately following the end of the war and because of the limitations on funds and personnel. In addition, questions in connection with the White Narrows project had not been fully resolved and the projects in the remainder of the Virgin River Basin were considered to be of a nature more in the province of the Bureau of Reclamation than of the Corps of Engineers.

The curtailment of the civil works program in the summer of 1950 resulted in discontinuing active work on a number of reports including that on the Virgin River. Since it is not known when the general policy of civil works curtailment may be modified so as to permit the resumption of work on the Virgin River report, it is impractical to estimate at this time when the final comprehensive report may be submitted.

Senator MALONE. May I intervene here, Colonel, and ask you just what is this limitation that has been put on the work there?

Colonel SHULER. The limitations, sir, are this, that it extends from the presidential criteria, it is a limitation placed on all studies of a preliminary examination or a survey nature and on planning for projects that are authorized which require that the project that is about to be built or for which money is needed be appropriated and the project that it is authorized for must be of a very high priority and in the national defense effort. I think, Senator, you mentioned that a little earlier when you talked about the police action in Korea. So, I happen to know this last year we got very much less appropriation than we asked for to do our preliminary examinations and survey studies. A great many of them are sitting on the shelf because of lack of funds to carry them on.

Senator MALONE. The reason for the budget not allowing the funds, then, is the established reason, that as long as the Korean police action or a similar action is in progress throughout the world, then any projects, in order to go ahead, must have a high national defense priority.

Colonel SHULER. Those are the instructions we have from higher authorities, yes, sir.

Senator MALONE. That would mean, I suppose—I would like to have you interpret it, Colonel, if you would—the generation of power for national defense or some flood control that endangered some national defense establishment, or in other ways connected directly with national defense. How would you interpret that?

Colonel SHULER. That is correct, sir. The fact of the matter is I have it in the presidential criteria here.

Senator MALONE. You might read it into the record. This is a very important order. As I remember it, nearly all of the Senators were in sympathy with such an order if the emergency or so-called police action could be terminated within a reasonable length of time. Of course, if it is going to go on for a long time, from one area to another, it would be necessary to construct some of these projects as well as foreign projects that are reclamation or power under the Marshall plan, the Mutual Security, the point 4, and so on.

Colonel SHULER. The instructions which I have from the Office of Chief Engineer, which I know stem down from President Truman—the instructions I have are:

The civil works program of the Corps of Engineers will be reviewed to insure that no new projects are initiated unless they make an important contribution to the war effort and that only those projects now under construction which meet one or more of the following specific criteria will be continued during the period of partial mobilization.

There follows these specific criteria, eight points:

(1) The project includes the development of power. (2) The project provides industrial or munncipal water supply in critical areas. (3) The project is a dam and reservoir project where construction is under way or has been effected and should be completed to a point of useful operation.

Senator MALONE. Does that mean that if there is a project under way and it is a necessary project that it can be completed?

Colonel SHULER. That is correct, if it is more economical to complete it to get it into operation, then that should be done.

(4) The project is an important harbor or waterway. (5) The project protects important industries or major food producing areas. (6) The project can be completed in the 1951 working season and where termination cost would constitute an appreciable economic loss, the work in place would be damaged if not protected and relatively small amounts of additional work will make the project fully effective. (7) The project involves almost entirely the movement of earth, such as channel improvements or levees and does not compete in the use of critical material. (8) Maintenance of completed projects advance planning of selected authorized projects, then survey program should be continued.

So, whatever you are doing it is on a selected basis and must prove itself in support of the present emergency. That in general, sir, is what I interpret it to mean.

Senator MALONE. Then you interpret that order to mean that if there was a need for additional power in a critical national defense area such as this has proven to be with its titanium and chlorine and other materials necessary for national defense, such dams might be constructed.

Colonel SHULER. My opinion of that, Senator, would be that they would qualify if it could be proved that they were necessary to keep the plants running with power.

Senator MALONE. And then if they were needed for a municipal water supply or an industrial water supply or in a critical area, we will say, where the water table, the underground water, is being used for municipal purposes and it was continually dropping and becoming critical, a project that would assist or clear this situation might qualify.

Colonel SHULER. Yes sir, I believe it would.

Senator MALONE. And food-producing areas.

Colonel SHULER. Important food-producing areas, yes sir.

Senator MALONE. It seems to me that the Pine and Mathews Canyon reservoirs might easily qualify, because there is a great danger there to the food-producing areas in the lower Muddy River, in the Moapa Valley. Are you personally familiar with that?

Colonel SHULER. Somewhat, sir, not too much in detail, but I have certainly studied it a lot and so forth.

Senator MALONE. You have studied it?

Colonel SHULER. Oh yes, I have studied it.

Senator MALONE. You may go ahead.

Colonel SHULER. With reference to the White Narrows project, principally an irrigation project, a recent report of the Bureau of Reclamation indicates it is a project that should not be undertaken at this time because it would be impractical for the beneficiaries to make repayments in accordance with reclamation law. Furthermore, no project at the White Narrows site could be justified for flood control alone because the annual benefits would not be sufficient to justify the cost of the construction of flood-control work, such as the dam or adequate channel improvement. As I recall in my review of the Bureau's report, incidentally, we review their reports and they review our reports.

Senator MALONE. You are talking about the Bureau?

Colonel SHULER. Yes, sir.

Senator MALONE. They do cooperate?

Colonel SHULER. Yes, sir. In our review of their report we noted that the flood-control benefits of the structure that they studied in their report were slightly over 1 percent, a very small amount of the overall cost of the structure. In addition to our invesigations in the Virgin River Basin, certain emergency flood-control work has actually been constructed. This consists of revetments and channel clearing, straightening of Clover Creek, and work on Meadow Valley Wash at Caliente, Nev. We do know that they have flood trouble at Caliente because periodically we are called upon to do emergency work up there during the flood seasons.

Senator MALONE. You are aware, and perhaps it may be covered later in your recital, that there have been times when the Union Pacific main line railroad has gone out for a good many days.

Colonel SHULER. That is correct, sir, as I remember in 1 year it went out for—Mr. Thompson you can correct me on it—it went out for over a month, did it not?

Mr. THOMPSON. Something like that.

Senator MALONE. And that is the only main line railroad through from Salt Lake City and southern Nevada into Los Angeles. The only other alternate would be the Sante Fe into Arizona or the Southern Pacific in northern Nevada, into San Francisco; isn't that true?

Colonel SHULER. I believe that is true, someone can check me accurately on that. As far as I know that is true, sir.

Senator MALONE. Then this is a very important order, especially as it affects the national defense industries around Hoover Dam.

Colonel SHULER. I believe that would be correct, yes, sir. A preliminary examination and survey of the Las Vegas Wash, returning now to the Las Vegas Wash problem.

Senator MALONE. Pardon me, in connection with Pine and Mathews Canyon Reservoirs, you might comment as to whether or not you think construction of these two projects would qualify, under your instructions.

Colonel SHULER. Senator, the only thing I can say to that is that upon inquiry by the Office Chief of Engineers as to my recommendation, I would most certainly make a recommendation. I would not like to state it now due to the fact that it might embarrass my higher headquarters. I think what you have said is entirely correct and I think that, I believe it is something very well worth going after, let me put it that way. I would have to make quite a study of it, check it carefully against this and just what its impact on critical materials and things like that would be before I could make an absolute recommendation.

Senator MALONE. I think these are spill dams, are they not?

Colonel SHULER. Yes, they do have your spillway and your ungated openings and so forth.

Senator MALONE. Is there any reinforcement steel?

Colonel SHULER. Yes, sir, with some reinforced concrete.

Senator MALONE. That would be a relatively small item.

Colonel SHULER. As compared to other dams; yes, sir, that is correct.

Senator MALONE. Now, who would be the person, or what agency should bring this to a head? Should you pursue it after this hearing and make a recommendation without further communications, or should the Public Works Committee take it up with the Chief of Army Engineers, or should the water users and the Union Pacific Railroad urge its completion? How should that be done?

Colonel SHULER. I would say the first two of these, sir. What I will do is make a report of this hearing to the Chief of Army Engineers and in that I will submit the data that we have talked about here. While I cannot officially say yes to your second suggestion, I think you understand that that would also be in order. Before I turn to the last item I have here, on Las Vegas Wash, I think that I should get in the record the status on the two dams so that everybody has an idea of that.

Senator MALONE. Very good.

Colonel SHULER. I am talking now about Pine Canyon and Mathews Canyon Dams, which, of course, are an authorized project. Pine Canyon and Mathews Canyon Dams, two flood-control improvements, were authorized by the Food Control Act approved May 17, 1950, as a result of the recommendation of the Chief of Engineers and House Document 530, 81st Congress, 2d session, and a recommendation of the district engineer, Los Angeles district, in an interim report on survey on Meadow Valley Wash and lower Muddy River, Nev., submitted in 1948. The authorized improvements are to be constructed on canyons tributary to Clover Creek, which enters

Meadow Valley Wash from the east of Caliente, Nev., and the upper part of the Muddy Valley drainage area. The Pine Canyon Dam site is about 3 miles upstream from Clover Creek and the Mathews Dam site is about 2 miles upstream from Clover Creek. Both structures are to be earth fill with ungated outlets and spillways. The upstream face of each dam will be protected by a layer of rough stone placed on gravel filter blanket. Pine Canyon Dam would be 2,003 feet long, including a dike extension across the saddle to the left, that is, west of the main structure. The top of the dam would be 97 feet high above stream bed. The reservoir would have a capacity of 7,840 acre-feet. Mathews Canyon Dam would be 717 feet long, the top elevation about 60 feet above streambed. The reservoir would have a capacity of 6,260 acre-feet. No storage for water conservation would be provided in either of the reservoirs. Each improvement would almost completely control the standard project flood and would materially reduce the maximum probable flood. Standard project flood, Pine Canyon, 10,500 cubic feet per second. Mathews Canyon, 8,500 cubic feet per second.

(The report of the Chief of Engineers on these projects follow:)

DEPARTMENT OF THE ARMY,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, D. C., September 12, 1949.

Subject: Meadow Valley Wash and lower Muddy River, Nev.
To: The Secretary of the Army.

1. I submit for transmission to Congress my interim report with accompanying papers on preliminary examination and survey of Virgin River and tributaries, in Nevada, Arizona, and Utah, authorized by the Flood Control Act approved June 28, 1938. This report covers Meadow Valley Wash and lower Muddy River only. A final report under the authorization will be submitted at a later date.

2. Muddy River in southeastern Nevada was formerly tributary to Virgin River but now flows into the Virgin River arm of Lake Meade which was created by the construction of the Hoover Dam on Colorado River. Meadow Valley Wash is formed by the confluence of Spring Valley Creek and Patterson Wash, about 9 miles southeast of Pioche, Nev., and flows southward about 95 miles to Muddy River near Glendale, Nev., about 21 miles above the former confluence of Muddy and Virgin Rivers. Meadow Valley Wash is the only major tributary to Muddy River and is much longer than the parent stream. Major tributaries to Meadow Valley Wash, in addition to the headwaters, are Clover Creek from the east and Antelope Canyon from the west which enter the wash near Caliente, Nev., at stream mile 73, and Cottonwood Wash from the east about 22 miles downstream from Caliente. Muddy River Basin has an area of 4,060 square miles, of which 2,460 square miles tributary to Meadow Valley Wash and 220 square miles along Muddy River below the wash comprise the area under consideration in this report. The basin of 2,680 square miles is a desert area consisting generally of a series of north-south trending mountain ranges and broad intervening valleys. One mountain mass with east-west orientation forms the southern boundary of Clover Creek watershed. Elevations in the basin range from 1,229 feet, the maximum water surface elevation at Lake Meade, to about 9,700 feet in the northern mountains. Meadow Valley Wash has an average slope of 38 feet per mile below Caliente and lower Muddy River slopes average 20 feet per mile. Average annual precipitation ranges from about 5 inches at the lower elevations to about 20 inches in the higher mountains.

3. Population in the area under consideration was estimated at 6,000 in 1948. Corresponding estimates of population in the principal towns are: Pioche, 2,000; Caliente, 1,500; Overton, 800; and Panaca, 550. Nearly all of the population is concentrated in agricultural areas and mining districts. Farming and stock raising, mining, and transportation are the principal industries. Farm crops are generally supplemental to cattle and sheep raising and in the higher elevations consist principally of alfalfa, meadow hay, and grain, although in the

lower areas specialty crops such as lettuce, cantaloups, sugar-beet seed, and other high-valued crops are produced in addition to field crops. Irrigation is essential to crop production in the lower areas and important in the higher altitudes. Pioche is the principal mining center. Among the minerals produced are zinc, lead, silver, gold, and copper. Extensive deposits of sand suitable for glass manufacturing and foundry use have been developed. The main transcontinental line of the Union Pacific Railroad enters the basin near the headwaters of Clover Creek and follows Clover Creek to Caliente, then Meadow Valley Wash to Moapa near the mouth of the stream where it leaves the area under consideration. Branch lines of the railroad run from Caliente northward to the Pioche mining area, and from Moapa southeast along Muddy River to Overton. The railroad provides employment for many along its route and at Caliente, a division point. Two Federal highways serve the area and are an important source of revenue from tourist trade.

4. Floods in Meadow Valley Wash and lower Muddy River Basin occured in 23 years of the 41-year period 1906 through 1946. Most of the floods occur in the winter as a result of general storms from the southwest. Influence of the mountains along the Clover Creek watershed causes high intensity precipitation in that area which quickly concentrates in the stream channels and produces a high crested flash flood wave. Due to this factor past flood damage has been most severe along Clover Creek, in Caliente, and along Meadow Valley Wash downstream. The flood of January 1910 was one of the most disastrous of history. It caused damages reported at $831,000 including a loss of $714,000 to the Union Pacific Railroad whose main-line roadbed was washed out along Clover Creek and Meadow Valley Wash. Railroad service was interrupted for more than 6 months. A flood in March 1938 inundated the tracks and severely damaged the roadbed, interrupting traffic for about 2 weeks. Estimated flood damage in 1938 amounted to $318,000 of which $188,000 was to the railroad. A flood in October 1946 caused total estimated damages of $280,000 including $226,000 to the railroad. Between 1906 and 1941, inclusive, the railroad company spent about $2,300,000 for restoration and more than $5,500,000 for relocation of the main line at higher elevations and for protective revetment of embankments and spur dikes. There are four overflow areas along Clover Creek, Meadow Valley Wash, and lower Muddy River, comprising 13,280 acres in which flood damages have been severe. Included therein is the town of Caliente, 2,360 acres of cultivated land, irrigation and drainage works, the railroad properties, roads, and utilities. Estimated average annual damages from future floods in these overflow areas amount to $96,800.

5. Local interest in the Meadow Valley Wash and lower Muddy River Basins request improvements for the control of floods and erosion and for the conservation of water by extensions and improvements of existing structures, check dams, improvements of stream channels and spreading grounds, and improvements for the protection of irrigation facilities. They state that flood-control improvements, especially flood-control reservoirs in Pine and Matthews Canyons, tributary to Clover Creek, would prevent land erosion and damage to property by floods, particularly damage to railroad property along Clover Creek and Meadow Valley Wash. They state that reservoirs and levees near the mouth of Antelope Canyon would provide additional flood control for improved areas just north of Caliente. They also desire multiple-purpose reservoirs for water conservation and flood control to provide additional water for irrigation in the semiarid region along Meadow Valley Wash and Muddy River.

6. The district engineer has investigated 4 plans of improvement: A channel-improvement plan; a multiple-purpose reservoir plan; and 2 other plans, each of which provides for 1 or more flood control reservoirs. He finds that the plans other than that for 2 flood-control reservoirs would not provide benefits commensurate with their costs. His most practicable plan of improvement provides for flood-control reservoirs in Pine and Matthews Canyons to control runoff to Clover Creek from the high intensity rainfall area along the south boundary of Clover Creek drainage area. Pine Canyon flood-control reservoir would be created by an earth fill structure, 97 feet in height above stream bed, on Pine Canyon about stream mile 3. The reservoir would have a capacity of 7,840 acre-feet and, primarily by automatic operation, would provide complete regulation of the runoff from a drainage area of 45 square miles. Matthews Canyon flood-control reservoir would be created by an earth-fill structure, 68 feet in height above stream bed, on Matthews Canyon about stream mile 2. The reservoir would have a capacity of 6,260 acre-feet and, primarily by automatic operation, would provide complete regulation of the runoff from a drainage area of

34 square miles. First cost of the improvements estimated on the basis of 1948 price levels is $1,776,000 of which $1,180,000 is for the flood-control reservoir in Pine Canyon and $596,000 is for that in Matthews Canyon. Total annual carrying charges are estimated at $74,800, which include $3,700 for maintenance and operation. The two flood-control reservoirs would effectively reduce flood flows in Clover Creek, at Caliente, along Meadow Valley Wash below Caliente, and along lower Muddy River, and produce tangible benefits from prevention of flood damage estimated to average $58,200 annually. In addition important intangible benefits would be realized from the improvements, among which are reduction in hazard to human life, elimination of menaces to health, preservation of community morale, some improvement of irrigation water supply, and, most important, the prevention of interruption of railroad traffic, which in time of national emergency might be vital. The ratio of tangible benefits to annual carrying charges is 0.78; however, the district engineer considers the intangible benefits to be of such great weight and commanding importance that they, together with the tangible benefits, would amply justify the construction of the improvements. Accordingly, he recommends construction of Pine Canyon and Matthews Canyon flood-control reservoirs at an estimated cost to the United States of $1,776,000, and $3,700 annually for maintenance and operation, provided local interests adjust all water rights claims resulting from operation of the improvements and keep the flood channels below the flood-control reservoirs free from manmade encroachments. The division engineer concurs.

7. The Board of Engineers for Rivers and Harbors concurs in the views of the reporting officers that the proposed improvements are needed and will produce, in addition to the tangible benefits, important intangible benefits including the prevention of possible loss of life. It finds, however, that the indirect but measurable benefits from preventing interruptions to rail service have been seriously underestimated, and that on the basis of records and statistics of the railroad involved, including consideration of traffic conditions in time of national emergency, the estimate of tangible benefits should be increased to at least an average of $110,000 annually. It also finds that the estimated construction cost of the 2 reservoirs should be increased to $1,986,000 in order to provide adequate allowance for construction contingencies in the relatively isolated area. The estimated annual carrying charges would be increased, correspondingly, to $83 200. Since the ratio of estimated benefits to cost is 1.32, the Board concludes that the expenditures required for the improvements are fully justified. Accordingly, the Board recommends construction of the flood-control reservoirs in Pine and Matthews Canyons, Nev., subject to certain provisions of local cooperation.

8. After due consideration of these reports, I concur in the views and recommendations of the Board. While important intangible benefits will result from the proposed flood-control reservoirs, the measurable tangible benefits including those from prevention of service interruptions on a major transcontinental railroad are clearly sufficient to justify the expenditures required for the improvements.

9. Accordingly, I recommend construction of two flood-control reservoirs in the Meadow Valley Wash drainage area, one in Pine Canyon, the other in Matthews Canyon, in Nevada, generally in accordance with the plans of the district engineer and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable, at an estimated cost to the United States of $1,986,000 for construction and $3,700 annually for maintenance, provided that responsible local interests give assurances satisfactory to the Secretary of the Army that they will adjust all water rights claims resulting from operation of the improvements and keep the flood channels below the flood-control reservoirs free from man-made encroachments.

LEWIS A. PICK,
Major General, Chief of Engineers.

PINE CANYON AND MATHEWS CANYON DAMS—STATUS, JULY 1952

1. *Authorization.*—Pine Canyon and Matthews Canyon Dams, two flood-control improvements, were authorized by the Flood Control Act approved May 17, 1950, as a result of the recommendation of the Chief of Engineers in House Document 530, 81st Congress, 2d session and the recommendation of the district engineer, Los Angeles district, in an interim report on survey on Meadow Valley Wash, and lower Muddy River, Nev., submitted in 1948.

2. *Location.*—The authorized improvements are to be constructed on canyons tributary to Clover Creek, which enters Meadow Valley Wash from the east of Caliente, Nev., in the upper part of the Meadow Valley Wash drainage area. The Pine Canyon Dam site is about 3 miles upstream from Clover Creek and the Matthews Canyon Dam site, about 2 miles upstream from Clover Creek.

3. *Pertinent data.*—Both structures are to be earth fill with ungated outlets and spillways. The upstream face of each dam will be protected by a layer of quarry stone placed on a gravel filter blanket. Pine Canyon Dam would be 2,003 feet long, including a dike extension across a saddle to the left (west) of the main structure. The top of the dam would be 97 feet high above stream bed. The reservoir would have a capacity of 7,840 acre-feet. Matthews Canyon Dam would be 717 feet long with top elevation about 68 feet above stream bed. The reservoir would have a capacity of 6,260 acre-feet. No storage for water conservation would be provided in either of the reservoirs. Each improvement would almost completely control the standard project flood and would materially reduce the maximum probable flood. (Standard project flood: Pine Canyon, 10,500 cubic feet per second; Matthews Canyon, 8,500 cubic feet per second.) The Standard project flood of 22,000 cubic feet per second on Clover Creek near its mouth would be reduced to 12,000 cubic feet per second. The standard project flood of 27,000 cubic feet on Meadow Valley Wash at Caliente would be reduced to 16,000 cubic feet per second.

4. *Cost.*—The total cost of the improvements is currently (July 1952) estimated at $2,205,000—$1,450,000 for Pine Canyon Dam and $755,000 for Matthews Canyon Dam—all of which would be a Federal obligation. (The total cost, when authorized, was estimated at $1,986,000.)

5. *Economic analysis.*—The improvements would provide a large degree of protection for the town of Caliente, partial protection for about 84 miles of the Union Pacific Railroad along Clover Creek and Meadow Valley Wash, and partial protection for about 13,000 acres of mostly agricultural land along Clover Creek, Meadow Valley Wash, and lower Muddy River. The value of the overflow area involved was estimated at about $10 million in 1948. The average annual benefits are estimated at about $110,000. The benefit-cost ratio is well above unity.

6. *Present status.*—No appropriation of funds has been made for this project because (1) Congress has shown an unwillingness to appropriate money for the initiation of new projects unless it can be shown that high priority is warranted for such projects, and (2) the Los Angeles district now has other projects well under way that have a high priority, particularly with respect to the national defense. Furthermore, all projects must meet certain criteria set up by the President, and, thus far, the priority of the Pine Canyon and Matthews Canyon Dams has not been established on the basis of those criteria.

Senator MALONE. Do I understand that there are no head gates as such on these dams; it simply slows down the outlet?

Colonel SHULER. That is correct. You have an ungated outlet at the bed level and the area of that outlet slows down the flow; yes, sir.

Senator MALONE. So that at maximum crest the spillway goes into use; this safety outlet is there.

Colonel SHULER. The standard project flood of 22,000 cubic feet per second in Clover Creek near its mouth would be reduced to 12,000 cubic feet per second, almost a 2 to 1 reduction. The standard project flood of 27,000 cubic feet per second at Meadow Valley Wash at Caliente would be reduced to 16,000 cubic feet per second. The total cost of the improvements is currently—that is at July 1952—estimated at $2,205,000. That is $1,450,000 for Pine Canyon Dam and $755,000 for Mathews Canyon Dam, all of which would be a Federal obligation. The total cost, when authorized, was estimated at $1,986,000. So, you can see a rise from $1,986,000 to $2,205,000, between the authorization date and now.

Senator MALONE. What are those dates, respectively?

Colonel SHULER. The one date of authorization is 1950 and the present date of refiguring the cost is July 1952. The 1950 date is May, so that is 2 years ago.

Senator MALONE. And what was the difference in the estimate?

Colonel SHULER. The difference in the estimate was $2,205,000 against $1,986,000, or roughly $208,000 difference.

Senator MALONE. What caused the difference?

Colonel SHULER. Can you answer that, Mr. Thompson? What caused the difference of the $208,000 rise between the authorization date and the present estimate?

Mr. THOMPSON. Ten percent increase in wage rates, construction index.

Senator MALONE. That would be what this country calls inflation, I suppose.

Colonel SHULER. We call it the rise in construction index.

Senator MALONE. Commodity index costs.

Colonel SHULER. Which amounts to the same thing. Things cost more; labor costs more in the last 2 years.

Senator MALONE. They were the same materials and the same labor cost 10 percent more at the end of 2 years beyond the initial estimated costs.

Colonel SHULER. That is true. That is the only rise; isn't that correct, Mr. Thompson?

Mr. THOMPSON. No change in the design.

Colonel SHULER. How about real estate; is there any change in real estate? So that would be yes, sir, to what you stated.

Senator MALONE. Simply an inflated cost due to the decreased purchasing power of the dollar.

Colonel SHULER. The improvements would provide a large degree of protection for the town of Caliente, partial protection for about 84 miles of the Union Pacific Railroad along Clover Creek and Meadow Valley Wash, and partial protection for about 13,000 acres of mostly agricultural land along Clover Creek, Meadow Valley Wash, and lower Muddy River. The value of the overflow area involved is estimated at about $10 million for 1948. The average annual benefits are estimated at about $110,000. The benefit-to-cost ratio is well above unity—it is 1.32 to 1.

Senator MALONE. And your 1 to 1 is what you would call unity.

Colonel SHULER. That is right, sir. Now the present status—this is the final on this. No appropriation of funds has been made to this project, and rather than read what I have here, it is because of what we have already discussed here—because of the presidential criteria, actually.

Senator MALONE. In other words, the order that you have read into the record as interpreted by the Chief of Army Engineers.

Colonel SHULER. That is correct, sir. And also in addition to that, the Los Angeles district now has other projects well under way that have a high priority, particularly with respect to the national defense.

Senator MALONE. Now we have decided, I think, that the project, these projects, are protection to a main-line railroad and other criteria would very likely come within the order of the Chief of Army Engineers; is that correct?

Colonel SHULER. It is possible. I believe the Bureau of the Budget also reviews each project against the criteria.

Senator MALONE. Would it be in order for the committee now to request that you do review it and advise the committe of your findings

and recommendations through the regular channels of the Army engineers?

Colonel SHULER. The question that you asked me, Senator, if it would be appropriate for the committe to request me to study the authorized project of the two reservoirs against the presidential criteria—in answer to that I would say, yes, it is proper and I would, on your request, make the study, make a recommendation to the division engineer, who in turn will make it to General Pick, Chief of Engineers. I would point out one thing, though, that the Chief of Engineers will in turn make a recommendation and, of course, the Bureau of the Budget has the final say.

Senator MALONE. I understand that, Colonel, but I think it is necessary to start at the lower end, so if you will do that, you may consider yourself requested to send in the proper recommendation. How long do you think it will take to arrive at your conclusion?

Colonel SHULER. I don't think it would take more than—Mr. Thompson, you are going to have to do it; maybe you could tell me. I am always putting Mr. Thompson on the spot. That is the reason I would like to get him to make the recommendation.

Mr. THOMPSON. About 6 weeks.

Colonel SHULER. I think we could put it this way, Senator: The date that the division engineer puts on the letter will be probably shorter than 2 months.

Senator MALONE. It would be available for the committee at the beginning of the 83d session of Congress?

Colonel SHULER. Yes, sir. Now, the last thing I want to comment on, sir, and then we stand ready to answer any questions that anyone may wish to ask us, concerns Las Vegas Wash flood control. The preliminary examination and survey of Las Vegas Wash for flood control and related purposes was authorized by the Flood Control Act approved July 9, 1952. However, a request for funds for this investigation was not included in our annual program for the current fiscal year because the request for funds for that program was prepared prior to the receipt of authorization of the investigation on Las Vegas Wash. Furthermore, the drastic curtailment of funds for civil works activities, as a result of the existing national defense emergency, has made it necessary to reduce the civil works program to a few outstanding projects and investigations, principally all of which had been started before the limitations on funds had been announced. Also, prosecution of our projects and investigations must be, as I have said before, in acordance with the President's program, which sets up criteria which places further limits on our civil works activities. Also as a result of the existing national defense emergency, a great many of my personnel normally assigned to civil works activities have been transferred from my office to our vital military construction work which we have to do for both Army and Air Force, both the design and construction, so actually I only have a skeleton crew available for work on our civil works program. I might say in conclusion, sir, as far as my formal presentation goes, that if we got the funds to start this preliminary examination which is authorized—of course, which could either lead to a survey report or not—my estimate would be 3 to 6 months to get it done properly. I went down this morning and spent 2 hours going over part of Las Vegas Wash, and I am fairly familiar with the lay of the land.

Senator MALONE. Well, you do understand or could find out in the preliminary hearings, which you will probably hold anyway in North Las Vegas and Las Vegas, that it is very dangerous to property.

Colonel SHULER. We will definitely hold hearings; yes, sir.

Senator MALONE. Do you suppose that at least the hearings could be held within the reasonably near future to determine if such a survey is justified?

Colonel SHULER. You mean the survey report or the preliminary examination that is already authorized? We need funds to initiate it, which would include the public hearing.

Senator MALONE. Are those funds being included this year?

Colonel SHULER. No, sir; they are not, because the request for funds went in prior to the time we got the authorized preliminary examination; and also, whereas I asked for a certain number of dollars for this type of study, I got a very minute portion of that in turn because of the curtailment that has been put on the civil works program by the national emergency.

Senator MALONE. In other words, this police action in Korea is definitely responsible for the delay of the Las Vegas Wash survey. Also, it has been definitely responsible for the delay in the Muddy River improvements.

Colonel SHULER. And the start of the authorized dams; yes, sir.

Senator MALONE. Do you have any further statements?

Colonel SHULER. No, sir; that is all I have.

Senator MALONE. Does anyone have any questions? I think that is all then, Colonel. You have covered the projects mentioned in the announcement of the hearing through your department that you believe your department is responsible for.

Colonel SHULER. Yes, sir; that is correct.

Senator MALONE. You will be available to answer any questions on the Colorado River if such should arise.

Colonel SHULER. That is correct, sir.

Senator MALONE. Thank you very much.

Colonel SHULER. Thank you, Senator.

Senator MALONE. I would like to call at this time Mr. Harvey McPhail, Assistant Commissioner of the United States Bureau of Reclamation. Mr. McPhail, you have heard the representative of the Army engineers testify they believe the development on the Colorado River is in the field of the Bureau of Reclamation and they would be ready, of course, for advice and counsel in the event anything in that field became a question. This entire power problem here in this area, as well as in the Southwest, I know you are entirely familiar with, beginning with the completion of Hoover Dam and farther back even than that date when the contracts were made, including the withdrawal of power for the State of Nevada and the State of Arizona and the conditions. Also, the withdrawal from Davis Dam, and you know the needs for power in this area. You are entirely familiar with the contemplated construction, under Senate bill 3487, of Bridge Canyon Dam and also for the necessity of storage above that reservoir, at Glen Canyon and possibly at other sites. You are the spearhead in preparing a contract for Shasta power for Nevada, 30,000 kilowatts that have been finally allocated to this area, and I believe you had a request from the Atomic Energy Commission to make a survey of

central Nevada which would include areas as far south as Ely, where that great copper development is the principal industry of the region. So, if this is proper, I will ask you to give us your conception of the proper coordination and interests of the available power and perhaps as far as Parker Dam comes into the picture in the Southwest and in this particular area, where, as you know, there are national-defense industries being consummated, including the titanium production. This coordination of power would not only be the immediate picture, which would be the Hoover Dam power or the Davis Dam power and the available Shasta power, but it would take in future possible withdrawals from the California Central Valley project to supplement a supply here. Now they are considering constructing Bridge Canyon and Glen Canyon Dams or whatever is necessary. The question to you then, for the benefit of the committee, would be to lay before the committee in January as complete a picture as possible not only of the needs now but for the future, perhaps 10 years hence, or however you would like to discuss it. I consider you one of the outstanding experts in this field, and your advice and counsel has often before been helpful to the committee, and I am sure it will be in this particular hearing.

STATEMENT OF HARVEY F. McPHAIL, ASSISTANT COMMISSIONER OF RECLAMATION, DEPARTMENT OF THE INTERIOR

Mr. McPHAIL. Thank you, Senator. I have no prepared statement, but I would like to speak for a minute or two on the general power situation in this particular area. The three developments of the Bureau of particular consequence in this area are the Hoover Dam, Davis Dam, and Parker Dam projects. The Hoover Dam, with the recent request of the State of Nevada, will have all of its capacity installed, of about 1,367,500 kilowatts. The Davis Dam is completely developed with 225,000 kilowatts; and the Parker Dam, 120,000 kilowatts. The energy from all of those three dams has been allocated and is in use. The energy output of the three developments on an average is something like 6 to 7 billion kilowatt-hours a year.

Senator MALONE. Six to seven?

Mr. McPHAIL. Six to seven billion, depending upon water conditions through the years. There are no other sources in this area—hydrosources—from which power can be withdrawn until such a time as additional dams and other developments are made on the lower Colorado River. The general power picture, particularly in southern Nevada, is dependent, in my opinion, on additional developments on the Colorado River. I think initially, for an interim period, there may be some possibility of securing offpeak generation particularly from these systems that are interconnected and worked in with the power available from Hoover and Davis Dams, so as to make some additions to the supply plus whatever you may be able to get from Shasta. The Colorado River itself, within the State of Arizona—that is, from Glen Canyon down to Hoover Dam—has potential possibility on the average of the next 50 years of something approaching 15 billion kilowatt-hours a year. It might be somewhat greater than that if all the developments were made early, and it would be somewhat less than that if the depletion continued by reason of upstream consumptive use in the basin. The dam which is closest to Hoover

Dam, next one above, is Bridge Canyon. Involved in the Bridge Canyon development, which has comparatively small storage capacity, is the need for silt control so that the storage capacity is not lost too quickly due to the silt. Glen Canyon will certainly do the job on the Colorado River itself. Cocomino Dam would do it on the Little Colorado. Those two combined would give the desired protection to Bridge Canyon. None of those structures are presently authorized for construction. The Bureau has done considerable engineering on several of them, and I have with me today Mr. Vaud Larson, who has been in active charge of the investigations on most of that work and can answer any detail questions that anyone might have in connection with it. I think that covers my idea of the present and future power picture.

Senator MALONE. Then, Mr. McPhail, what would be the number of kilowatts or horsepower or kilowatt-hours available from the Bridge Canyon in conjunction with Glen Canyon?—or you might give them separately. We do understand that Bridge Canyon would not be too efficient without Glen Canyon, but you might let us know for the benefit of the record what the value would be of Bridge Canyon and then a combination of Bridge and Glen Canyons; and then, if you will, a combination of Bridge, Glen, and Cocomino on the Little Colorado.

Mr. MCPHAIL. I would like to just give you an overall picture in rough figures and ask Mr. Larson to give you any details you want. The river in total, from Glen Canyon down through Bridge Canyon, has a potential of about 15 billion kilowatt-hours a year, probably involving an installation of 3,100,000 kilowatts. Bridge Canyon itself has been considered as about 750,000 kilowatts, with an output which varies from something like 4½ billion kilowatt-hours in early years to 4,100,000,000 kilowatts, an average of about 4,300,000,000. I think, if you want more details than that, it would be much better for Mr. Larson to speak. He is much more familiar with those details than I am.

Senator MALONE. Is the decrease of generation of power due to the increasing use of water in the upper-basin States?

Mr. MCPHAIL. That is correct; the same picture that has always been considered in connection with Hoover Dam. If you will recall, in the determination of the firm power at Hoover Dam, an estimate was made that probably on the average the amount of firm power would decrease 1,000 kilowatts constant use per year, or 8,760,000 kilowatt-hours. So that over a 50-year period there would be a decrease of about 50,000 kilowatts in the average firm-power output.

Senator MALONE. What is the length of time in which it is estimated that the uper-basin States might beneficially utilize all the water allocated to them?

Mr. MCPHAIL. I don't know that there has been any such estimate made; that is, to the extent of trying to pin down the way that area would develop in certain years or a period of years.

Senator MALONE. There is a certain amount of water, however; 7½ million acre-feet allocated to the upper basin that they may beneficially utilize at any time that they can, or, to put it the other way around, 75 million acre-feet in each 10-year period which they may allow to pass a certain point in the river which is predicated on a divi-

sion of the water between the upper-basin States and the lower-basin States. There is about 7½ million to each basin; is that correct?

Mr. McPHAIL. Well, as I understand, the Colorado River compact requires the upper-basin States to undertake to deliver, over any given 10-year period, at least 75 million acre-feet to the lower basin.

Senator MALONE. And the estimate of the flow of the river over a period of years is generally conceded to be about one-half of the river.

Mr. McPHAIL. I am not a water expert, and I can't answer that. I have a general idea that is about it, but I am not certain.

Senator MALONE. I am bringing out the fact that they would be about to utilize almost half of that water for beneficial consumptive use, meaning in the last analysis perhaps only about half the water would pass a certain point in the river; it might be a hundred years or it might be 50 or any period of time. Is there any question that anyone would like to ask Mr. McPhail in regard to this development? Feel perfectly free to ask any questions, because our purpose is to get the best information we can before the committee of what the future development holds for the lower basin.

Mr. HARLEY BRADLEY. What are the possibilities of taking electric energy into this area from the new gasline or oil system?

Senator MALONE. I think that is a question entirely apart from Mr. McPhail. Do you have any knowledge regarding that particular project?

Mr. McPHAIL. No knowledge whatever; I don't know.

Senator MALONE. Someone here will no doubt have the information as to the amount of gas that will be allocated to this area. Anyone else have a question? Well, Harvey, if we have this full coordination, and supposing it would be possible to have the developments you have mentioned, what part of the total power might be firm power? What part of that 15 billion kilowatt-hours annually?

Mr. McPHAIL. Proper integration with the developments on the river and with the developments that are connected with the generating system, it would approach the full amount being firm. There will always be some small slice; but, in general, the entire amount, in my opinion, for practical purposes, would be considered as the possible firm output in the future.

Senator MALONE. That is, if you could coordinate the use of all of the dams from Parker to Glen Canyon. Taking into consideration the annual use by the industries with domestic use, all of it would be considered firm power after final development.

Mr. McPHAIL. I think so. The river would certainly be fully controlled with storage capacity that would be involved in reservoirs like Glen Canyon and the existing Lake Mead. Therefore, it should lend itself to being in essence all firm generation.

Senator MALONE. If there are no further questions then, Mr. McPhail, we will call our next witness, but you will be available for further information, would you not?

Mr. McPHAIL. Yes, I will, Senator.

Senator MALONE. Thank you. There have been some witnesses who arrived after the original rollcall. L. A. Spalding, of the North American Aviation Co.; Mr. Spalding, are you present? L. M. Hitchcock, of the Boeing Airplane Co. George W. Papen, of the Lockheed Aviation Corp. They have just arived and probably just stepped out, but

they are here and will appear later. Mr. Rollin Smith, of the Titanium Corp., has sent word he will be here at 3 p. m. C. D. Baker, 10 a. m. tomorrow, Saturday. Art Newell, of Stauffer Chemical Co., tomorrow morning. Roy Martindale, of Stauffer Chemical Co.

Mr. MARTINDALE. Here.

Senator MALONE. Fred Weiss, of Stauffer Chemical Co., will arrive from Los Angeles today. Fred Gibson is waiting for his representative from Los Angeles, who will appear. Mr. Gibson will be here this afternoon. This is just supplemental information that might be of interest to the witnesses present. Now, we have Julian Hinds, former chief engineer and general manager of the Metropolitan Water District, Los Angeles. Donald M. Keith, representing Mr. Hinds. Raymond Matthew, chief engineer of the Colorado River Commission of California, and Samuel B. Morris, general manager of the Los Angeles Department of Water, Light, and Power. The committee will defer to their wishes as to the order in which they would like to be called. Do you have any preference? If not, we will call Donald M. Keith, representing Julian Hinds, general manager of the Metropolitan Water District.

Mr. KEITH. Our interest in the matter, that is the interest of the Metropolitan Water District, being simply as an allottee of the Hoover power and having entitlement for a part of Parker power for the purpose, of course, only of pumping water into our aqueduct, Colorado River aqueduct, I do not know that there is much that we could add to the committee's hearing. We are interested, of course, in the preservation of our rights on the lower river.

Senator MALONE. Then your organization, the Metropolitan Water District, to the best of your knowledge, would enter into any and approve any development that would not impair your rights.

Mr. KEITH. We would, of course, favor any development on the river for the purpose of development of power or for flood control that did not impair the existing rights of the district.

Senator MALONE. There is no information that you have to offer at this time, any methods to be used for developments or any suggestions.

Mr. KEITH. I have no suggestions, but perhaps Mr. Elder, our hydmologist, might have something to say.

Senator MALONE. Is he present?

Mr. KEITH. He is present; yes, sir.

Senator MALONE. All right, Mr. C. C. Elder, do you have any information to offer the committee? Are there any statements you would like to make?

Mr. ELDER. I have no comment, Senator.

Senator MALONE. Thank you, sir. You understand that the objective is to find out and determine facts for the committee as to what could be done.

Mr. KEITH. Yes, sir; and of course, we are willing at all times to cooperate in any way possible.

Senator MALONE. I am sure you are. Thank you. Raymond Matthew, chief engineer of the Colorado River Commission of California. This is Raymond Matthew, chief engineer of the Colorado River Commission of California, from Los Angeles. I have known Mr. Matthew for many years; from when he first was employed by the State engineer's office in California. He has long been a student of power and

water development on the Colorado River. Mr. Matthew, do you have a statement that you would like to make for the benefit of the committee on this general development problem in the availability of that power on the Colorado River?

STATEMENT OF RAYMOND MATTHEW, CHIEF ENGINEER, COLORADO RIVER COMMISSION OF CALIFORNIA

Mr. MATTHEW. Senator, I haven't prepared any special statement for this hearing, but I might make a few observations. California, along with the entire Southwest, is very vitally interested in additional hydroelectrical power developments on the lower Colorado River if it could be developed on a sound, businesslike basis. As Mr. McPhail brought out, there is a vast potential development remaining on the lower Colorado River above Lake Mead extending up to the vicinity of Marble Canyon of about 15 billion kilowatt-hours on the average energy output.

Senator MALONE. That would be the total energy output including the present development.

Mr. MATTHEW. Well, from Glen Canyon to Bridge Canyon.

Senator MALONE. Fifteen billion additional kilowatt-hours.

Mr. MATTHEW. Fifteen billion kilowatt-hours on the average.

Senator MALONE. That would make a total then of how many kilowatt-hours annually, including the present development?

Mr. MATTHEW. The present development is producing from 5 to 6 billion kilowatt-hours depending on the amount of water so that you would have a total of somewhere around 20 billion kilowatt-hours. These remaining developments above Lake Mead have been studied for many, many years and the latest investigations are those made by the Bureau of Reclamation. The main developments outlined are Bridge Canyon, with 750,000 kilowatts of installed capacity, and an average energy output of 4½ billion kilowatt-hours. The next one above that which has been outlined by the Bureau is the so-called Kanab Creek powerplant where there is a proposed installation of 1,100,000 kilowatts and an estimated average energy output of 6,750,000,000 kilowatt-hours. That proposes a tunnel around the Grand Canyon National Park heading in Marble Canyon Dam. Marble Canyon Dam itself would have 22,000 kilowatts. It is just a small plant, with a small amount of water. It is presently proposed, or at least the last report that I have seen, with 150 million kilowatt-hours. Then Glen Canyon up above Lees Ferry, with a present installed capacity of a proposed 800,000 kilowatts and an average energy output of 3,750,000,000 kilowatt-hours. Now, all of this power or a large part of it could be absorbed in the Southwest power market if it were made available on a sound basis within in a comparatively short time.

Senator MALONE. What would you consider a sound basis, Mr. Matthew?

Mr. MATTHEW. I mean that a sound basis, a similar setup program to Hoover Dam, which was set up on a sound business basis with the power to be paid for, in that case, in a period of 50 years with 3 percent interest.

Senator MALONE. It was 4 percent to start with, wasn't it?

Mr. MATTHEW. Four percent to start with, that was changed by the Boulder Canyon Project Adjustment Act of 1940 to 3 percent, so that

the entire cost along with interest is paid into the Federal Treasury. The taxpayers do not have any worry whatsoever. In other words, it is a sound business venture. The other powerplants, power developments we believe, should be set up on the same basis.

Senator MALONE. You would recommend that the same arrangement be made in the installation of all the generators. I was State engineer of Nevada at the time, and a member of the Colorado River Commission, and I remember that we had a lot of discussions in this regard and we set it up selling falling water so that the Government didn't actually install any generators or any transmission lines, but sold the falling water at a certain price to the company and allowed each one of the companies to take care of their own generation and transmission.

Mr. MATTHEW. Senator, I think, as to that question, I would defer to Mr. Samuel Morris and Mr. Peterson to answer it. I think that the present arrangement on Boulder Canyon project, Hoover Dam, has been a very good one from the standpoint of all concerned. Of course, it would finally rest with the Congress as to how the additional developments, if and when they go ahead, would be set up.

Senator MALONE. Certainly, we understand that, but the purpose of this hearing is to lay before the Public Works Committee the suggestions and plans, if any, by the interested parties, or would-be interested parties, on the basis of their past experience, which, of course, you are doing. I think that the recommendations of the original users of Boulder Dam power, Davis Dam, Parker, in all likelihood would be extended to a good part of the Glen and Bridge Canyons power, would be of much interest to the committee. Of course, you understand that the committee would have the say until it is presented on the floors of the Senate and the House. The men there improve—they call it improvement of the bill—but it is the initial ideas that we are getting at now to lay before the committee. I think you are very helpful.

Mr. MATTHEW. I am sure that Mr. Morris can give you a better idea of that than I can. I thought that you might be interested in a very brief picture of this power market and how this power could be so readily absorbed. The hydropower so far developed on the lower Colorado River, as we have said before, has been fully absorbed, Hoover, Davis and Parker. With that hydropower all used, the Pacific Southwest has had to install huge amounts of steam-electric capacity in order to meet the demands. Since 1945 there have been built and placed in operation 898,000 kilowatts of steam-electric capacity, 771,500 kilowatts of capacity in southern California alone. In addition, there are already planned for installation, by the end of 1954, 1,325,000 kilowatts of additional steam-electric capacity, of which 1,085,000 kilowatts will be in southern California. These are nameplate ratings, I might say. So it is very clear that all the hydroelectric power remaining to be developed on the lower Colorado River could readily be absorbed; in fact, a substantial portion, practically the entire output of Glen Canyon and Bridge Canyon, could have been in the market area in the past 10 years. Its availability would have avoided the necessity of building a considerable part of the steam-electric capacity that has had to be installed in order to meet the power demands. It also would have resulted in a large saving of fuel oil. The

15 billion kilowatt-hours a year potential hydroenergy represents from 25 to 30 million barrels of fuel oil to produce the equivalent amount of energy in steam-electric plants. So, the question naturally arises, Why haven't these plants been built in view of the great need for additional power. I wish to point out, briefly, that, for instance on the matter of Bridge Canyon, the development of that project, for which definite plans have been set up to my knowledge, going clear back to the days when Hoover Dam was being built, has been held up because of the fact that certain interests, particularly in Arizona, have sought to tie in an uneconomic irrigation project to that power development and that has held the authorization up, up to this time.

Senator MALONE. As a matter of fact, back in the old days of Davis there were engineering reports available, in general, on all the subjects from Parker to Glen Canyon.

Mr. MATTHEW. That is correct.

Senator MALONE. They have been, of course, improved upon since that time, by more detail survey, but these developments have been contemplated for a long time.

Mr. MATTHEW. They have been contemplated for many, many years. The plans have been improved in recent years by the Bureau of Reclamation, and there may be still other changes to come. There are serious questions that have been raised in connection with the Marble Canyon development, I mean the Kanab Creek powerplant, for instance, as to interfering with the Grand Canyon National Park. The proposal to divert out of the main river through a tunnel around the park would leave only a small amount of water in the canyon. The national-park people question that development. The Kanab development is probably the most expensive one in the whole line of proposed powerplants, so that it would probably come in last in any development program.

Senator MALONE. The committee would like to have any information you might have on the power cost per kilowatt hour. You might express it for each of these proposed developments separately and give an average.

Mr. MATTHEW. The fundamental estimates in these developments insofar as any figures that I have knowledge of are those made by the Bureau of Reclamation. On Bridge Canyon, for instance, with its additional features and taking into account the fact that costs have increased in the last year or so, Bridge Canyon power would probably cost 4½ mills or more per kilowatt-hour of average energy output.

Senator MALONE. That is switchboard?

Mr. MATTHEW. That would be depending on where the power was disposed of, the actual cost including 50-year amortization and 2½ to 3 percent interest, would run 4½ mills or more. Somewhere between 4½ and 4¾ mills per kilowatt-hour.

Senator MALONE. Where would that deliver the power?

Mr. MATTHEW. It would deliver the power in southern Nevada and some points in Arizona and possibly to southern California, although there are not very definite cost estimates on that.

Senator MALONE. At least it is relative to the general center of distribution.

Mr. MATTHEW. That is right. It is not cheap power, as you see, like Boulder (Hoover) Dam power, which was built at a time when

costs were low so that the Southwest has had the benefit of fairly cheap power from Hoover Dam. There is no more cheap power on the lower Colorado River.

Senator MALONE. That is compared to Hoover Dam power.

Mr. MATTHEW. That is compared to Hoover Dam power or compared to power in some parts of the Columbia Basin for instance. Now the Bureau's estimate on the cost of power at Glen Canyon, which is shown on the report of the upper basin storage project, is about 4½ mills a kilowatt-hour delivered at load center. So, as you see, we are getting into the realm of 4½- to 5-mill power and the Bureau is now thinking in terms of selling power for around 5½ mills per kilowatt-hour, as their most recent reports indicate, at load center.

Senator MALONE. How would this cost of the development of Bridge Canyon and Glen Canyon compare to Boulder, now Hoover Dam, at the time Hoover Dam was constructed? Do you have any figures on that? What I really want to arrive at is what would be the difference in the cost in the last 25 years in construction, per kilowatt-hour.

Mr. MATTHEW. I don't think I can give you a very accurate estimate of that. My guess would be that the cost has increased from 33 to 50 percent. In other words, Hoover power would cost at present-day prices, anywhere from 33 to 50 percent more.

Senator MALONE. It might be then, that this 4½-mill power that you have discussed would have been around 3 mills at the time that Hoover Dam was constructed.

Mr. MATTHEW. I think that is right, 3 to 3½ mills.

Senator MALONE. Of course, that is to be understood as the advantage of hydroelectric power. After it has once been constructed, whatever it does cost, there is very little increase in the cost over the years ahead, because there is no fuel involved and only labor, maintenance, and operation.

Mr. MATTHEW. That is correct. The big cost in hydro power is the capital cost, as compared to steam. The big cost in steam power is the operation and maintenance and fuel costs, which will always continue and vary with the cost of fuel. Just a word about the Glen Canyon project. Glen is presently proposed as a unit in the upper basin storage project, and as set up, would be the main power unit of the upper basin storage plan, which includes 10 storage dams, would generate the bulk of the power and would carry, as set up in the financial program, a large part of the investment in the upper basin. There seems to be some thoughts in this upper basin plan that the power should be reserved chiefly for use and for the benefit of the upper basin, which is somewhat at odds with the reality of the situation in that the Glen Canyon power development is closest to the Southwest and the main market now and in some years to come would be the Southwest, that is southern Nevada, Arizona, and southern California. It may be that such a proposal to make that power only useful in the upper basin would hold up that development, whereas if it is authorized along with Bridge Canyon and as has been pointed out in your introductory remarks, Senator, Glen Canyon is essential for the most effective use of Bridge Canyon, not only to equalize the flow but to provide for the silt control on the main river. Those two projects together constitute the best possible development for additional hydro-electric development on the Lower Colorado River.

Senator MALONE. Would you explain, for the benefit of the record, just where Glen Canyon and Bridge Canyon together with the reservoir sites are located?

Mr. MATTHEW. The Glen Canyon Dam site is a few miles above Lee Ferry, which is a point dividing the upper basin from the lower basin as defined in the Colorado River compact, so that the dam site is in the upper basin. It is also located in the State of Arizona. The reservoir is in the upper basin.

Senator MALONE. How far above Lee Ferry is the dam site located?

Mr. MATTHEW. Around 10 miles. Bridge Canyon site is just at the head of Lake Mead in the lower basin.

Senator MALONE. The reservoir is located in the lower basin also?

Mr. MATTHEW. Yes, entirely. Bridge Canyon is entirely in the lower basin, including the reservoir. Glen Canyon Dam and Reservoir would be in the upper basin as defined in the compact. We believe that the mutual interests of Arizona, Nevada, and California are such that if it could be set up on a sound feasible basis, those two projects represent the best power program that has been proposed for this region, as far as additional hydro is concerned.

Senator MALONE. And also for a national-defense purpose, if a demand developed, as it seems that it will?

Mr. MATTHEW. That is right. It is very important, particularly in this area and also in Arizona and in southern California.

Senator MALONE. Do you have any information as to the time element in the construction of these two reservoirs? Supposing that such legislation and construction were to proceed in accordance with regular action by Congress and approved construction methods?

Mr. MATTHEW. Of course, Hoover Dam was built in about 3 years. If given sufficient money, I believe that it would be possible to complete those dams in 5 years, both of them. Of course, that would depend upon the availability of funds, and appropriations by the Congress.

Senator MALONE. In other words, it is a 5-year job from the time the first money becomes available, providing the appropriation is a sufficient appropriation each year for economical construction of the Bridge Canyon Dam. It would probably entail around 7 years, assuming that there would be no difficulty in passing a bill and in securing an appropriation and starting construction.

Mr. MATTHEW. I imagine that would be true, Senator.

Senator MALONE. A couple of years is consumed in passing the legislation and securing the appropriations if there were no undue opposition and delay?

Mr. MATTHEW. That is right.

Senator MALONE. That is one objective of the hearing, of course, in coordinating the use of this power, including the Shasta power and possible other sources in the Central Valley Project, and how this power is being made available up until this time, to proceed in an efficient manner with the development of the national-defense projects necessary now.

Mr. MATTHEW. I think that is all I have to say at this time, Senator. Thank you for the opportunity of appearing.

Senator MALONE. We thank you for your testimony. From what you know about your own Colorado River Commission and the in-

dustry in the Southwest, would you say that if the committee took up the subject of the construction of these projects, could be introduced in the 83d session, they would have to be reintroduced, and the committee took up this problem, in general would you represent it as southern California being in favor of the construction of these projects?

Mr. MATTHEW. I believe they would, if they were set up on a sound basis, as I stated.

Senator MALONE. I think that you and I and other oldtimers, Ed Hyatt, Mike Hinderlider, who had something to do with setting the Hoover Dam project up on what we thought was a sound basis—there has been considerable departure from that basis now—but I think—I cannot speak for our Colorado River Commission, of course, I am not a member of it now, but I think they are quite in favor of the sound basis. Is there any question that anyone would like to ask Mr. Matthew?

VOICE. How does the cost of producing steam power compare with hydroelectric power?

Mr. MATTHEW. That depends on the situation, each case and each region and each project would be different and I would say this, I think that Mr. Peterson who may appear a little later is more familar with the up-to-date figures on steam costs than I am, and could better answer that question for you.

VOICE. A 7-year period is quite a long period for this expanding——

Mr. MATTHEW. That is quite true, and that is why, in the Southwest in Arizona and in southern California, particularly, these large steam plants have had to be put in and more of them are being put in right at the present time, that is true in northern California also. The loads have increased tremendously and they have to meet that load, so they have to build steam plants, because there is no hydro available.

Senator MALONE. What is the cost, do you know, what is the cost in these steam centers for gas for a thousand cubic feet?

Mr. MATTHEW. I will ask you to defer that question to Mr. Peterson.

(Mr. Matthew submitted a printed statement entitled "Last Great Hydro Power Source.")

LAST GREAT HYDRO POWER SOURCE

In weighing the relative beneficial uses of the Colorado River's great outpouring of water Raymond Matthew, chief engineer of California's Colorado River Board, points out that the Pacific Southwest must look to the River as its last great hydro power source.

The last substantial source of hydroelectric power potentially available to the Pacific Southwest is the lower Colorado River between Lake Mead and the vicinity of the Arizona-Utah boundary. In this 250-mile canyon section of the river is a fall of about 2,500 feet that can be developed. The present average annual flow is about 12,500,000 acre-feet with about 10,000,000 acre-feet in the critical period 1931–40. This may be reduced by future use of water in the upper Colorado River Basin to an average of about 8,500,000 acre-feet with a minimum of 7,500,000 acre-feet annually.

Thus, there exists a huge power potential which under full development would aggregate about 2,500,000 kilowatts in capacity with about 15,000,000,000 kilowatt-hours in average annual energy output.

PREVIOUS DEVELOPMENTS

Investigations and planning for development of hydroelectric power on the Colorado River have been under way for 40 or 50 years, both by private and governmental agencies. In the early years, as well as subsequently, the United States Geological Survey took a leading part. One of the early investigators was E. C. LaRue. His first report on the Colorado River and its utilization was published in 1916; Water Supply Paper 395. This was followed in 1925 by his classic report on Water Power and Flood Control of the Colorado River; Water Supply Paper 556.

The United States Reclamation Service also made extensive investigations. These resulted in another of the classic reports dealing with the development of power and irrigation on the river, the so-called Fall-Davis report, published in 1922. It was this report that was particularly directed to advancing the proposed Boulder Canyon high dam development in contrast to low dam developments advocated by LaRue. The 1922 report was followed by the Weymouth report in 1924, which further advanced the proposal for Federal construction of a high dam at or near Boulder Canyon.

Prior to and during the twenties plans for private power development were actively promoted with applications filed under the Federal Power Act. The issues that arose over conflicting proposals were finally resolved in 1928 with the passage of the Boulder Canyon Project Act. The authorization and subsequent construction of Hoover Dam and power plant set the pattern of plans for further development on the lower Colorado River.

Since the building of Hoover Dam there have been 2 additional power developments completed on the lower river below Hoover, namely, the Parker Dam and power plant of 120,000-kilowatt capacity completed in 1943, and the Davis Dam and power plant placed in operation in 1951, with an installed capacity of 225,000 kilowatts. The total capacity of hydro plants already built, including Hoover with an ultimate installed capacity of 1,327,500 kilowatts, aggregates 1,672,000 kilowatts.

POTENTIAL DEVELOPMENT

There remains to be developed for the Pacific Southwest the huge power potential between Lake Mead and approximately the Arizona-Utah boundary. According to the most recent plans of the United States Bureau of Reclamation, the power potentialities in this section of the river would be developed in four projects as shown on accompanying map and profile. These would comprise the Glen Canyon Dam and power plant, the Marble Canyon Dam and power plant, Kanab Creek tunnel and power plant, and Bridge Canyon Dam and power plant. The presently proposed installed capacity and estimated average annual energy output of each of these plants are set forth in table I.

TABLE I

Plant	Gross reservoir capacity	Power plant installed capacity	Estimated average annual energy output first 50 years
	Acre-feet	*Kilowatts*	*Millions of kilowatt-hours*
Glen Canyon	26,000,000	800,000	3,750
Marble Canyon	500,000	22,000	150
Kanab Creek		1,100,000	6,750
Bridge Canyon	3,720,000	750,000	4,400
Total	30,220,000	2,672,000	15,050

The principal market area for the potential hydroelectric power on the lower Colorado River, designated herein the Pacific Sorthwest, comprises the entire State of Arizona, southern Nevada, and southern California. According to a power market survey report issued by the Federal Power Commission in 1950, the load demands in this area increased during the period 1940 to 1948, 1,447,900 kilowatts in demand and 8,070,700,000 kilowatt-hours in energy output. In southern California alone the increase in this period was 1,164,500 kilowatts in peak demand and 6,426,600,000 kilowatt-hours in energy output; in Arizona, 200,700

kilowatts and 1,024,300,000 kilowatt-hours; and in southern Nevada, 82,700 kilowatts and 619,800,000 kilowatt-hours.

As of 1952 the total load in the Pacific Southwest is estimated at about 4,100,000 kilowatts in peak demand and a corresponding energy load of about 22 billion kilowatt-hours; and for southern California alone, about 3,400,000 kilowatts in peak demand and 18 billion kilowatt-hours in energy output.

According to estimates by the Federal Power Commission, in the report above referred to, power demands of the Pacific Southwest will continue to increase during the next 20 years at an average rate per year of 205,000 kilowatts demand and 1,060,000,000 kilowatt-hours in energy output; and for southern California alone, 193,000 kilowatts demand and 910,000,000 kilowatt-hours in energy.

All of the hydro power thus far developed on the lower Colorado has been fully absorbed in the market. The 4½ billion kilowatt-hours of Hoover firm power and all available secondary were fully used by 1943. The half billion kilowatt-hours of Parker hydro were absorbed almost immediately after it went into operation. The most recent Davis Dam hydro power was all disposed of by contract even before operation started and is all in use at the present time.

In order to meet the demands in the Pacific Southwest, the utilities have had to install huge amounts of steam-electric capacity. Since 1945 there have been built and placed in operation 898,000 kilowatts of steam-electric capacity; 771,500 kilowatts of capacity in southern California alone. In addition there are already planned for installation by the end of 1954 1,325,000 kilowatts of steam-electric capacity, of which 1,085,000 kilowatts will be in southern California. These figures are nameplate ratings. Actual operating capacities may be 10 to 25 percent greater.

From the foregoing appraisal of the power market, it is clear that all of the hydroelectric power remaining to be developed on the lower Colorado River could readily be absorbed. In fact, a substantial portion, practically the entire output of Bridge Canyon and Glen Canyon, could have been used in the market area during the last 10 years. Its availability would have avoided the necessity of building a considerable part of the steam-electric capacity that has had to be installed in order to meet the power demands. It also would have resulted in a large saving of fuel oil. The 15 billion kilowatt-hours a year of potential hydro energy represents from 25 to 30 million barrels of fuel oil to produce the equivalent amount of energy in steam-electric plants.

The question naturally arises: "Why haven't these power projects been built, in view of the great need for additional power in the Pacific Southwest?"

There have been numerous obstacles causing delay; some physical, some financial, and some political.

In the first place, the State of Arizona has sought to maintain the position that the power resources in this section of the river within the State of Arizona belong to that State and hence should be developed, used, and controlled for her primary benefit. In line with this position Arizona filed an application in the thirties with the Federal Power Commission for a permit to develop the Bridge Canyon project. The proposal was opposed by the other basin States and particularly by the Department of the Interior, on the ground that Bridge Canyon and other potential power projects on the Colorado should be developed for the benefit and use of the entire region and should be constructed and operated by the Federal Government in accordance with the precedent established by the Boulder Canyon project. Accordingly, the proposal did not materialize.

However, Arizona's efforts to secure preferential benefits from the Bridge Canyon power development have been continued by the proposal to make it a part of the so-called central Arizona project. This proposal has been and continues to be the main obstacle to further power development on the lower Colorado River.

CENTRAL ARIZONA PROJECT

The main features of the central Arizona project, as reported and recommended by the Bureau of Reclamation in the project report transmitted to the Congress in 1948, comprise the Bridge Canyon Dam and power plant, a 241-mile canal extending from Parker Dam to the vicinity of Phoenix, with pumping plants on the river to lift the water nearly 1,000 feet into the canal, a second canal continuing from the Salt River 74 miles southerly to the Gila Valley; and miscellaneous storage dams and works within central Arizona. The cost of the project as estimated by the bureau in 1951 would be $788,265,000.

The stated main objective of the project would be to furnish a supplemental irrigation supply to preserve or "rescue" 225,000 acres of presently irrigated

lands in central Arizona. The construction cost allocated to irrigation is estimated at $450,000,000 or substantially $2,000 per acre on the area to be rescued.

The irrigation water shortage in central Arizona, although accentuated in recent dry years, is recognized to have been caused by overdevelopment of irrigated lands in areas of known deficiency in water supply, under the impetus of large speculative profits during and subsequent to World War II, particularly in the growing of cotton. Between 200,000 and 300,000 acres or more of new land have been placed under irrigation during the last decade. New land development is still going on in the face of the known fact that the underground water supplies used chiefly for new developments have been seriously overdrawn and depleted for several years.

Because of the huge cost of the irrigation features, the water users would be able to pay operation and maintenance costs only and, consequently, the repayment of the $450,000,000 construction cost would have to be met from other sources. This is where the proposal by Arizona to include Bridge Canyon as a part of the undertaking comes into the picture.

From the standpoint of its main objective, irrigation, the reason stated in the Bureau's report for including Bridge Canyon in the overall project is to furnish electric energy for project pumping. One-third of the annual output of Bridge, about 1,500,000,000 kilowatt-hours, is proposed to be used for this purpose, without any charge to the project water users for repayment of the construction cost involved. However, it is obvious that Bridge Canyon would not have to be tied in with the irrigation scheme in order to become a source of power for project pumping. It could be authorized and built independent of the proposed irrigation project.

Bridge Canyon Dam would have no physical connection with the irrigation features of the project, which would begin 275 miles downstream. It would conserve no water. The project water supply would come from the storage behind Hoover Dam in Lake Mead.

The chief reason for inclusion of Bridge Canyon in the overall project is to secure power revenues to finance the entire cost of the irrigation undertaking as well as the power features.

In order to obtain the amount of revenue required for the irrigation subsidy, it is proposed by the Bureau to sell the energy output available for commercial disposal, two-thirds of the total, at a higher price than would be required if Bridge Canyon were developed as a separate power project. The excess price the power users would have to bear for this purpose would be at least 0.6 and quite possibly as much as 1.0 mill per kilowatt-hour.

But that would provide only a part of the irrigation subsidy. The major portion would come from the Bureau's proposed use of the 3-percent interest, the interest component, on power investment, included in power rates and collected in power revenues. This would amount to 2 mills or more per kilowatt-hour in the power rate. Thus, the total subsidy would be about 2.5 to 3 mills per kilowatt-hour, out of a total rate of 5.2 to 5.5 mills per kilowatt-hour at load center.

The interest component subsidy would be at the expense of the Nation's taxpayers. In June 1950, the Secretary of the Interior reported to the House Committee on Interior and Insular Affairs that the cost of interest alone to the Nation's taxpayers for the central Arizona project, over a 75-year repayment period, would be in excess of $2 billion.

The proposed project is by far the most costly single reclamation undertaking ever conceived or submitted to the Congress. Its extravagant cost has caused people all over the country to begin questioning such huge expenditures for western reclamation.

The Bureau of the Budget reported on February 4, 1949, that authorization of the project is not in accord with the President's program. Bills to authorize the project, which have been pending in the Congress each session since 1947, have thus far failed of passage. The Senate has twice approved a bill for authorization but the House Interior and Insular Affairs Committee has so far refused to approve the legislation. Thus, Arizona's insistence on including Bridge Canyon development in an infeasible irrigation undertaking continues to prevent the consummation of the Bridge Canyon development as a power project.

KANAB PROJECT

One of the serious obstacles confronting the Kanab project is the interference with and possible adverse effects on the Grand Canyon National Park. The project is opposed by the National Park Service as well as conservationists in

general, because of the proposal to divert the bulk of the riverflow out of the canyon, which they believe would be seriously detrimental.

However, the relatively high cost of this project, resulting in a cost of energy, according to preliminary estimates, substantially exceeding present costs of steam-electric power, may long delay or possibly preclude this development being undertaken.

GLEN CANYON PROJECT

The Glen Canyon project, the farthest upstream power project potentially available to the Pacific Southwest, has been beset by various obstacles. Only recently were explorations concluded by the Bureau of Reclamation, during which several alternate sites were explored, and a site finally selected and preliminary plans for the dam and powerplant completed.

Perhaps the main obstacle that has contributed to delay and may still further delay the consummation of the Glen Canyon project is the position taken by the Upper Basin States that this project should be built as an integral part of the upper Colorado River Basin development and for the primary benefit of the Upper Basin States and other projects proposed therein.

Glen Canyon Dam is essential ultimately to the upper basin in order to provide the required holdover storage to furnish the minimum deliveries of water to the lower basin under the provisions of the Colorado River Compact. However, the Upper Basin States want the project included as an integral part of the upper basin storage development for the purpose of using power revenues therefrom, including the interest component thereof, to subsidize other more costly storage and power projects and also irrigation projects proposed in the upper basin.

It is further proposed that the upper basin shall have preferential use of the power output. A bill, S. 3013, recently introduced provides, in effect, that any contracts for sale of power outside the upper basin shall be on a temporary basis and subject to cancellation.

This proposal is unrealistic, in that it fails to recognize the obvious fact that the natural market for Glen Canyon power is the lower basin, the Pacific Southwest, and that in fact the Pacific Southwest offers practically the only market for this power for many years to come, particularly if other power projects proposed in the upper basin are built in the near future.

It is hardly reasonable to expect that any of the agencies in the Pacific Southwest, lower basin, would care to enter into any contract for the purchase of electric energy from the Glen Canyon project under the terms and conditions proposed in the legislation as introduced.

Such unrealistic planning for the Glen Canyon project, if continued to be insisted upon by the Upper Basin States, could very possibly delay its consummation indefinitely.

SOUND POWER PROGRAM NEEDED

The most meritorious power projects remaining to be developed on the lower Colorado River are the Glen Canyon and Bridge Canyon projects. These two projects, if developed on a sound financial basis without the heavy financial burdens required to subsidize other less economic undertakings, would provide about 8,000,000,000 kilowatt-hours of electric energy annually at fairly reasonable cost for domestic, municipal, and industrial use, and contribute large benefits to the region and the Nation. This amount of hydroelectric energy would be capable of saving 13 to 16 million barrels of fuel oil annually.

These projects should be authorized and constructed simultaneously. The Bridge Canyon development alone, without the large storage to be provided by Glen Canyon, would be a run-of-the-river plant, with less than half the average energy output firm. Furthermore, even with the Coconino Reservoir constructed for sediment control on the tributary Little Colorado River, the sediment inflow would be sufficient to fill Bridge Reservoir to the upper power outlet in about 25 years and to spillway level in 28 years. The large storage in Glen Canyon Reservoir is needed not only to equalize the river flow and obtain the full amount of firm output at Bridge Canyon but also to provide necessary sediment control to protect the reservoir and powerplant.

All of the Pacific Southwest States, Arizona, Nevada, and California, are vitally interested in the consummation of a financially sound power development on the lower Colorado River, which would provide hydroelectric power at reasonable cost and enhance the possibilities of commercial and industrial expansion.

In view of the mutual interests and benefits to be derived, it is to be hoped that such a power development program can be agreed upon and brought to early realization.

Mr. McPHAIL. Senator, I just had a long-distance call from Washington advising me that Secretary Finletter had just called my office expressing the interest of the Army Air Force, in particular, in this hearing. He regretted that he didn't have a representative present and asked that we do everything that we could to indicate his interest in all aspects of this that would have to do with materials that would affect airplane production, and that he would like to be informed of what was presented in connection with this.

Senator MALONE. I would like to ask you, Mr. McPhail, if you could communicate with the Secretary—he has been notified recently—that the matter would be taken up with regard to the availability of power in the immediate future, and of course, looking ahead, the construction of future projects on the Colorado River, which would take some time but perhaps have some time limit regarding the national defense if needs were urgent enough. I think it is very important that Secretary Finletter have someone here who can testify as to the needs for titanium producion, which requires approximately 20,000 kilowatts for every 10-ton-per-day unit of production. Are you prepared to give us any information as to the urgency of the production of this metal for airplane production?

Mr. McPHAIL. I have no direct information myself, it is outside the Interior Department and I do not have information.

Senator MALONE. I wonder while you are here if you could answer a question discussed by Mr. Matthew, as to the time element in the construction of these projects, presuming that a reasonable time would be required for the legislation and appropriation, under a national-defense emergency, and the time that would be required for actual construction after the first appropriations were available on the Bridge and Glen Canyon sites.

Mr. McPHAIL. Senator, my estimate, assuming reasonable availability of materials would be about 5 years after construction funds were made available, insofar as the structures themselves are concerned. The Bridge Canyon development, due to small reservoir capacity, could be relied upon to give pretty full production the first year. The Glen Canyon development is somewhat different, in that the very large reservoir capacity will probably take some time to acquire necessary storage to get the head up to a point where you can expect full production.

Senator MALONE. In other words, with the demands through Hoover Dam and Parker Dam and Davis Dam, there would be a limited storage available; is that it? It would take a longer time to fill the reservoir in Glen Canyon, for instance?

Mr. McPHAIL. It would take a longer time, because of a reservoir that size.

Senator MALONE. About 26 million acre-feet; is that the capacity?

Mr. McPHAIL. About 26 million acre-feet, which approaches 2 years' total runoff of the Colorado River, so it would be affected a great deal by the runoffs that would be that available starting with the time that storage could be affected. A series of dry years might drag out the period in which the reservoir could be filled for a long time and a period of good years might fill it very soon.

Senator MALONE. Assuming, what we might call a normal year, whatever that is, together with the demands of these lower projects, what would be your estimate of the time to put Bridge Canyon and

the Glen Canyon into full operation, producing the maximum amount of power, about 3 million acre-feet for Bridge and about 26 million for Glen.

Mr. McPHAIL. Senator, I would like to have someone who knows more about it than I do answer that question. Mr. Larson, could you give an estimate of that? Perhaps you could defer the question until he comes up; I can't answer it.

Senator MALONE. I have a letter here from Mr. Finletter. I have had this letter in my possession for 6 or 8 months. It is marked "confidential" on several places on each page, therefore I do not feel that it could be used in the record. At the same time I feel that there must be a considerable amount of this information that could be released for general information. I would ask you to urge the Secretary to have someone appear here who would know what we could use in the record, something that the committee would have to use in executive session. If you will communicate with him, this hearing can be held over until Monday or Tuesday and can be recessed until a representative arrives here. I feel it is so very important that someone should be here to discuss the matters contained in this letter of May 7, 1952, and also other information that he may have at this time. I wouldn't want to make this letter public without his permission.

Mr. McPHAIL. It seems to me, Senator, that you are in a much better position to make that request to Secretary Finletter, since I have no great indication of his interests.

Senator MALONE. Yes; I intend to do that, but I thought in view of the fact that he has asked you to represent him that you might tell him of the limitations of the representations. That is all for now, Harvey. Thank you very much. I have Samuel B. Morris, general manager of the Los Angeles Department of Light and Power. Mr. Morris, we are glad to see you here. I know how busy a man you are. I also know how important are further developments of the Colorado River resources, for power and water for your department. Would you like to make a statement in view of the information that you have heard this morning?

STATEMENT OF SAMUEL B. MORRIS, GENERAL MANAGER, LOS ANGELES DEPARTMENT OF LIGHT AND POWER

Mr. MORRIS. I would like to say that we are happy to participate in this hearing. In operating a public utility we must always furnish power and water on time and have planned ahead the sources of water and power which are necessary to meet the needs of our community. In the field of power that has been discussed, Mr. McPhail has given you figures and Mr. Matthews has discussed it from the standpoint of the Colorado River Board. I am a member of such board. We would like to see the developments take place on the Colorado River in the interest of developing additional hydroelectric power. If the lower river is developed up to the full additional capacity of 15 billion kilowatt-hours a year it would save some 25 to 30 million barrels of fuel oil a year, which in itself is a vital item of national defense. I happened to attend a hearing yesterday in which there was a complaint about the extent of drafts upon the fuel oil of California to meet the

demands of Korea. We have fortunately developed in California additional fields which have kept us able to secure sufficient fuel oil to date, but there have been times when there have been very narrow margins of fuel oil available to meet our needs, and we are still expanding, as we must. Steam plant installations take care of our needs as hydroelectric power has not been developed on time. As the principal source of hydroelectric power for the Southwest is the Colorado River at the sites which have been discussed from Glen Canyon to Bridge Canyon, we feel, as Mr. McPhail has expressed, that the Glen Canyon project is a fundamental necessity of construction with Bridge Canyon in order that the storage of silt be provided for and that river regulation be provided and it should also have some factor of flood-control regulation in it as well as other river regulation capacity. Mr. Matthews has mentioned our support of power developments on a sound financial basis. I believe those of us who are in the municipal power field endorse that principle fully.

The American Public Power Association, of which I am a past president, has emphasized that point because we seek to stand on our own feet in the responsibility of furnishing power to our consumers and not seeking separate Federal subsidies and so on. The remaining sites on the Colorado River will be more expensive to develop than was the Hoover Dam. Power can no longer be produced for new projects at a very low rate, but we believe with the proper design and execution that there is power which can be made available to the Southwest, and I believe those markets are growing so that the power can be absorbed as rapidly as it may be brought in. If brought in, the hydroelectric rates have an advantage over the steam plants which we are of necessity building. Of course, our department of water and power has a major interest in the Metropolitan Water District of California, so we have an interest through that agency in the future water supply for Los Angeles from the Colorado River brought to us through the Colorado River aqueduct by the Metropolitan Water District.

Senator MALONE. Do you have any further information for the benefit of the Public Works Committee at the moment?

Mr. MORRIS. I don't know that I have. We came here without any formalized statement. Mr. Peterson, Mr. Bateman, Mr. Durk, and Mr. John Matthews are with me and can answer any further questions which may be requested. We, in the current year, have increased our powerload by approximately 9 percent and our peak this year will exceed a million kilowatts, so that we are looking annually for a substantial block of power. Since the war we have added 290,000 kilowatts at our Harbor steam plant. We have nearly completed 112,500 kilowatts of hydroelectric power in Gorge. We have under way 512,000 kilowatts in steam plant in the San Fernando Valley, which shows the necessity of continued investment power-producing equipment, both hydroelectric and steam.

Senator MALONE. Might I ask what the average growth of power in your own organization has been over the past several years and also of the entire southern California load, if you know.

Mr. MORRIS. I do not believe I can speak for the whole southern California load; I know that Bateman can do that as can Mr. Peterson. I believe our load has in the long-time period increased from 7 to 8 percent, hasn't it, Mr. Bateman, annually?

Senator MALONE. Your own particular power over a number of years. Would you have an estimate of what the entire southern California, say south of Tehachapi, had increased on the same period annually?

Mr. MORRIS. I believe it is at least equal to that. Mr. Bateman, I believe, can give you the actual figures on that, or Mr. Peterson.

Senator MALONE. Mr. Morris, I am very glad to have your statement in the record. You understand the moving factor of this hearing is to determine the amounts of power in these various centers that is necessary for the usual load and the extra loads for national defense purposes, the urgency of such developments, and the coordination the power from the various sources for the purpose of a higher load factor or a more efficient use of the power available. With that in mind, you feel that your organization would support such developments as have been outlined here today, on what you call a sound business basis.

Mr. MORRIS. Yes, that is correct, and our agency would like to secure such large blocks of power as it is able to secure. We recognize that the developments are of general benefit to all of the Southwest. We recognize that the Glen Canyon site itself is in the upper basin. I might say, you asked a prior question I believe, about its location relative to the boundary between the upper and lower basins. It is my understanding that Glen Canyon Dam, as presently proposed, is 14 miles above Glen Ferry, or Lee Ferry, which is the boundary point between the upper and lower basins. The great markets for that power which are immediate and which are in coordination with developments down to Bridge Canyon and Hoover lie in the lower basin, the sites all lie within the State of Arizona. We believe that the development of such a program would be of vast benefit to each of the States of the Southwest, and the Southwest has become a very important factor in the national defense. Our own area is perhaps the greatest in concentration of the aircraft industry. The largest field of the aircraft is in the southern California areas which are receiving the benefits, currently, of Hoover Dam power. I think it is fair to state that not only has the amount of power which we receive through Hoover Dam been diminished by the annual diversions upstream depleteing the river, but also by the power withdrawals, which are in accordance with the Boulder Canyon Project Adjustment Act, have taken place so that our department of water and power, as a public agency, is getting much less power from Hoover Dam and will continue to get much less power and is not a participant in the additional power made available through the Davis Dam and the Parker Dam.

Senator MALONE. In other words, as Nevada and Arizona make use of their power, which we are entitled to do under the withdrawal privilege under the contracts, then, of course, to that extent your use is lessened.

Mr. MORRIS. But during the period when those two States were not making use of their opportunities at the Hoover Dam, and the Metropolitan Water District was not using as much power as it ultimately required, through not pumping as much water, we had for a time become accustomed to securing 50 percent of the kilowatt-hours of Hoover Dam. Finally our rights dropped down to about 19 percent, so that we have to replace those kilowatt-hours with steam power production.

Senator MALONE. What is the cost generally of firm power generated through oil and gas or fuel in that area?

Mr. MORRIS. I would like to have Mr. Peterson reply to that. Throughout California the answer to that is a complicated question because of the fact that all of our systems with the exception of San Diego Gas & Electric, are built up as combination hydroelectric and steam systems under which we use the steam to carry the hydro into the increments of demand and the peak loads that can't be met by hydro, and that varies annually by the type of rainfall and runoff which may be available, so that you have quite a wide variance in the load factor on our steam plants.

Senator MALONE. Yes, I understand that, Mr. Morris. I had more in mind the theoretical cost based on the price of fuel at this time, realizing that there would be no firm cost due to the factors that you mentioned. Just the estimate based on the price of fuel. Do you think Mr. Peterson would be able to answer that?

Mr. MORRIS. I think he would; yes. I might say there is one figure used by the State of California in connection with its Feather River project, the development on the coast, in transmitting inland to pumping plants and that production and transmission was a little over 6 mills. That is the figure that the State developed for that exclusive development. I don't know its load factors, and so forth.

Senator MALONE. What was the price of oil, generally speaking, for such a development?

Mr. MORRIS. The closest price I believe currently is $1.75 per barrel isn't it?

Mr. PETERSON. About a $1.80 delivered.

Senator MALONE. That is quite a lot of difference from the 80 cents that we used when Boulder Dam was first under consideration, as a comparison figure. Mr. Morris, we are very glad to have you here and have your statement and we would like to hear from Mr. Peterson. You will be available this afternoon, will you not?

Mr. MORRIS. Yes.

Senator MALONE. Thank you for the present time. Mr. Peterson, would you like to supplement the information given by Mr. Morris? This question has been deferred to as to the matter of cost. Would you like to make a general statement on the hydroelectric costs and the steam-power costs together with the price of fuel in a matter of comparison?

STATEMENT OF W. S. PETERSON, ASSISTANT MANAGER, LOS ANGELES DEPARTMENT OF WATER AND POWER

Mr. PETERSON. With respect to costs, the public always expects you to come out with one figure, and I think that is a total impossibility because the figure always varies from year to year depending on the availability of hydro energy in a given project, and also steam is similarly affected because the amount of energy used in our systems in this area depends on the amount of available hydroelectric energy the steam making up the residue. Generally speaking, we anticipate that these future projects, Glen and Bridge Canyons, for example, ought to have costs that will come in just a little bit under steam costs. I would think that the figures that Mr. Raymond Matthew has given

you are about as good as we can come up with at the present time. In the long run, we would defer for a final cost on those things to estimates to be made by the Bureau of Reclamation, as they get into exact details for estimating the projects. Now in respect to steam costs, we find that our results not only depend on load factor as do the hydro, but they depend on the efficiency of the plant. We have older plants that take more oil for the amount of energy, and they depend on how much better future plants will be. They also, of course, depend on the price of oil. At the present time the fixed charges on steam are such that they can be best expressed if we take out of the picture the fuel cost, by saying they are in the vicinity of $15 per kilowatt per year.

Now, if you want to use that kilowatt for a limited number of hours, you can get the kilowatt-hour cost by putting those hours into that. To illustrate: If we use one of these kilowatts for 5,000 hours and $15 would be represented as the cost, you can see that that kind of kilowatt-hours would have 3 mills added to it for the fixed-charge component. If there were lesser or more kilowatt-hours or higher or lower load factors that would correspondingly change that figure. Now with fuel at the present level, plant efficiencies vary so that we have, maybe under modern plant conditions, 500 to 600 kilowatt-hours per barrel of fuel oil. If such a barrel of fuel oil costs a $1.80 as it does at the present time, and if you have a very efficient plant running 600 kilowatt-hours per barrel, that is in the vicinity of 3 mills. Those two things combined there with the figures I have illustrated would point up to the 6-mill figure that Mr. Morris mentioned the State is using. Now they can vary widely from that. It can be lower and it can be higher. In each case in an economy such as ours where hydro and steam power are both involved and in use in the same system we have to look at the problem on its own merits at the time the thing is actually under consideration. An important point to realize is, that in making long-term contracts for power from these projects we can't come too close to that difference. I mean if steam power was 6 mills, we wouldn't want to buy hydro power for something just under 6 mills, for example, and try to guess what is going to happen in 50 years to the price of oil, it might go up and it might go down. You would have to have reasonable latitude to invite contractual relationships. However, we do believe that those projects that we have spoken of fall in that category. Having, I think, answered those questions, which you had in mind that were deferred to me, I would like to reiterate that we are definitely interested in the power projects being developed. With respect to Glen Canyon, I would like to make a point which has not been made yet, and that is this: The upper basin need for Glen Canyon to serve as a reregulating reservoir for the water that they are sending down the river so that they might comply with the 75 million acre-feet over a 10-year period, is a need that will develop many years in the future.

In the meantime, the powerplant development in connection with the Glen Canyon Reservoir can serve as an economic means of getting that project into action and made available for the future use of the Upper Basin States, with a certain portion of the reservoir being paid for at that time due to the power output that has come from it. I believe that that kind of cooperative effort should be encouraged. I think we should indicate that the power market for all of these plants

is the power market that is just in the Upper Basin States, and in Arizona, Nevada, and California. Probably, because of the lay of the land, southern California is a more nearly natural market through interconnection. Northern California probably would not be totally devoid of interest in the matter. I want to emphasize again that the market can absorb the power. Southern California alone has approximately 3,400,000 kilowatts of capacity in use, or load, I should say, and the energy is of the order of 18 billion kilowatt-hours, and from the figures that Mr. Morris has given, stated in another way, we double our use of capacity and energy every 10 years. So, those figures already would show that that much of the area alone could absorb the total capacity of the river that has been spoken of even in so short a period. When you add to it the potentialities of power consumption by Arizona, Nevada, and the upper basin, due to the developments that you have spoken of, you can readily see that there is no question about the market being there for the power enterprise, and we sincerely look forward to its development. One other point that I would emphasize is—it was touched on by Mr. McPhail—that as you fill Glen Canyon Reservoir, you of necessity have to let water through on downstream to support the other power projects that are in operation. That is, Hoover Dam still has to get its allotted amount of water and deliver its energy which can only be accomplished by bypassing or passing through Glen Canyon for the time being. Glen Canyon there is spilling, so to speak, to break off surplus water. That has some immediate effect on secondary energy reduction in Hoover, but in the long run, with the greater amount of future firm energy, it is a sacrifice that has to be made. We believe also that the coordination of operation of these plants with Hoover has to be accomplished so as not to upset the rights of allottees and agencies at Hoover. I might say that the presence of a large reservoir at the top end of a system, such as Glen Reservoir, greatly facilitates doing that. I would not anticipate any difficulty in complying with the coordination to the extent that the Hoover allottees would have to be imposed on in the least. I am sure it can easily be worked out. That constitutes the informal statement that I desire to make at this time.

Senator MALONE. I gather from your statement and from Dr. Morris' statement that the development of power, the use for it in your area, perhaps for national defense alone in southern California and in Nevada and perhaps in Arizona, that the demand would easily be utilized in the power that could be generated at Glen Canyon and Bridge Canyon in a very short time. In other words, if it would be used, theoretically, for national defense alone, there would be almost that amount of load at the present time; is that right?

Mr. PETERSON. I can't tell you in terms of just the defense quantities alone.

Senator MALONE. It is tremendous.

Mr. PETERSON. There is a lot of it; yes. I would not, without checking, want to answer you "Yes," but with defense industry also goes defense housing and the growth of the communities. We find it very difficult to separate defense load from the other loads of the community; we have to talk in terms of a community load. I can't answer without study.

Senator MALONE. I was thinking more, Mr. Peterson, for the demand and the reason for this development without delay. Now, Hen-

derson right here, of course, our cities are much smaller; the people overlook the fact that the same emergency exists here, but on a smaller scale. The Colorado River Commission met here yesterday, I think, to determine if they could in some way provide additional power for heating and lighting and general domestic purposes in this area.

Mr. PETERSON. That emphasizes the point I am making; you can't just add up the defense loads as being the sole urge; you have to add these other things that go with it. We look at the total picture, and the total picture indicates clearly that you should use these resources.

Senator MALONE. One particular point that I want to make is that the national-defense use which causes this emergency, only for the national-defense use, there would be plenty of power for the domestic uses, and if it were to be separated and put on a national-defense emergency basis only, which might be necessary to do, it will show the present need for the development of these reservoirs. You heard the Army engineers state, for example, and this is directly for national defense, that these projects should not be considered at this time. With these developments that we now have, Hoover Dam, Davis Dam, Parker Dam, with such a large amount of their output used for national defense and for urgent purposes due to the emergency, causes this additional domestic shortage. Naturally you can't separate them. There could be an estimate made of this national-defense demand which causes other shortages, could there not?

Mr. PETERSON. I believe there could, within reason.

Senator MALONE. I would like very much, I think the committee would be very much interested if you could, if it wouldn't take too much of your time, give us a supplemental statement as to the uses in southern California and Nevada and perhaps Arizona, of power for national defense, which in turn causes the shortage about which you complain.

Mr. PETERSON. In the course of compiling the prospective loads and load estimates for the Pacific Southwest interchange group, which includes your interests in southern Nevada and Arizona, we obtained figures which don't set out in detail the extension between what is truly defense load and what is the rest of the load. The agencies involved might be able to set that out. In our own case, we could take the responsibility of estimating a portion of our load that is definitely defense industry and combine it or separate it from the combined values which we get. I don't think we would be in the situation of our own court, except to serve as a compiling agency, the effects that pertain to Arizona and Nevada. Actually, we are the compiling agency for some of these loads and would be happy to set them out separately.

Senator MALONE. I would appreciate if you would do that.

Mr. PETERSON. It would require some other groups to work with us, maybe the Edison Co. in their area and the Arizona's area is separately considered so they would have to compile their own.

Senator MALONE. If you would attempt that, and give us some kind of an estimate the committee would give you any assistance they can. I had hoped to complete your testimony, but some of the witnesses here would like to attend a service-club luncheon and we would just as soon adjourn and continue at a quarter to 2. That would give us time to get back from any service-club luncheon. We will now recess the meeting until 1:45.

(Whereupon, at 12 noon, the subcommittee recessed to reconvene at 1:45 p. m., the same day.)

AFTERNOON SESSION

Senator MALONE. The committee will come to order.

I have a wire from E. A. Thomas, chairman of the Arizona Power Authority. The wire just arrived and I had overlooked the Arizona members that were here with their representatives. The wire is addressed to me as chairman, and is as follows:

Previous commitments prevent me from attending the hearing on Colorado River power and flood-control problems. K. S. Wingfield, administrator, and Howard Thompson, authority attorney, will represent the Commission. Best regards.

E. A. THOMAS,
Chairman, Arizona Power Authority Commission.

Is Mr. Wingfield present?

A VOICE. He was here this morning, Senator, I expect he will be back.

Senator MALONE. Is Mr. Howard Thompson present? I guess they will be here soon. Will someone call my attention to their arrival? Now, Mr. Peterson, has he come back; we were going to continue his testimony. While we are waiting for Mr. Peterson, I recognize the Colorado River Commission members and their engineers who are here. Jack Buehler, will you stand up and introduce the members of the Commission that are with you and your engineer or secretary, whoever you have with you?

Mr. BUEHLER. I regret that the only other member of the Colorado River Commission here at the moment is Frank Strong. Jim Shaver, who is the Chief Engineer for the Colorado River Commission will be here in a few minutes.

Senator MALONE. Thank you, Jack. Mr. Peterson will be called in when he arrives, and we will try to record the hearing so that the testimony will be connected. Mr. Preece, of the United States Indian Service is here. Will you come forward, Mr. Preece? Mr. Preece, you have heard the purpose of the meeting and testimony so far, do you have any statement that you would like to make for the benefit of the record?

CLAIR J. PREECE. I believe not, Senator, as far as the Indian Service interest in the Colorado River drainage area, we have the reservation at Moapa, that is as far as my jurisdiction is concerned. It is a small amount of Indian land we have at Moapa. Probably Mr. Parnell could explain something down south, on the Mohave Reservation.

Senator MALONE. Mr. Parnell is here?

Mr. PREECE. Yes; Mr. Parnell is here.

Senator MALONE. Well, if you have completed whatever statement you want to make, we will call on Mr. Parnell.

Mr. PREECE. Well, if I were to make a statement I would just say that we had 600 or 700 acres of irrigable land in the Moapa Indian Reservation, on which we are reserving the water right for irrigation. We are very much interested in the White Narrows Dam as a partial flood-control project and for further irrigation developments. The Indian Service has made a study on the White Narrows Dam but in late years it was sort of turned over to the Bureau of

Reclamation, who I believe, have made further study to combine it with the people in the lower valley down around the lower part of the river.

Senator MALONE. What is the status of the White Narrows Dam site?

Mr. PREECE. The last that we knew anything about it is that the Bureau has recommended that at this time it would be too expensive and not an economically feasible project due to the high cost of production, construction, and other things.

Senator MALONE. What is the source of water that you now use on this six or seven hundred acres?

Mr. PREECE. Moapa or Muddy River.

Senator MALONE. What part of the entire land irrigated under the Muddy River does this six or seven hundred acres constitute?

Mr. PREECE. I am sure I don't know.

Senator MALONE. There are about 24 second-feet in the river.

Mr. PREECE. This six or seven hundred acres would require about 12 second-feet, if you figure a second-foot per 50 acres or something like that.

Senator MALONE. You wouldn't have enough water, would you, in the whole river?

Mr. PREECE. That is right, we should have further development for the land below and probably for the Indian reservation.

Senator MALONE. You are a part of this development on the lower Muddy River, are you not?

Mr. PREECE. That is right.

Senator MALONE. How are they conducting that development? Is there anyone here that understands what they are doing in the lower Muddy River development?

Mr. PREECE. It would be some of the Bureau people, I guess, as far as I know.

Senator MALONE. Do you have anything further?

Mr. PREECE. No, I believe not.

Senator MALONE. Then, is Mr. Parnell here? Mr. Parnell, what are your initials?

Mr. PARNELL. My initials are Robert M.

Senator MALONE. And what is your title?

Mr. PARNELL. I am project engineer of the Colorado River Reservation.

Senator MALONE. And where is that located?

Mr. PARNELL. The agency is located at Parker, Ariz.

Senator MALONE. Do you have a statement that you would like to make in regard to the reservation?

Mr. PARNELL. We have no prepared statement of any kind, but the area director requested that I appear and try to answer any questions that the committee might have in relation to the Indian reservations along the lower Colorado.

Senator MALONE. In other words, you just want to be made a part of any additional development or any additional water that is made available through storage or in other manner. Is that about the statement you would like to make?

Mr. PARNELL. I think so, with respect to the water rights that the reservations have.

Senator MALONE. What rights do they have?

Mr. PARNELL. Well, they have various rights on the Colorado River.

Senator MALONE. Are they corporate rights?

Mr. PARNELL. They are granted rights.

Senator MALONE. What do you mean, granted rights?

Mr. PARNELL. Well, in the organization of the reservations the water rights were given in executive order, creating the reservation.

Senator MALONE. In other words, they withdrew water for the entire area of the reservation?

Mr. PARNELL. Irrigable areas.

Senator MALONE. How much is under irrigation now?

Mr. PARNELL. On the Colorado River Reservation, 33,000 acres are developed.

Senator MALONE. And what is the potential development?

Mr. PARNELL. Under gravity potential there is 105,000.

Senator MALONE. And you figure you have a water right for the 105,000?

Mr. PARNELL. Yes.

Senator MALONE. Is that established?

Mr. PARNELL. It is established until 1962 when reallocations of the Colorado River are to be made.

Senator MALONE. Is there any further statement that you would like to make?

Mr. PARNELL. No, not unless there are any questions.

Senator MALONE. Are there any questions anyone would like to ask Mr. Parnell? I guess that is all then, Mr. Parnell. I see that Mr. Peterson has arrived and if you will come up, Mr. Peterson, we will complete your statement.

Mr. PETERSON. I am sorry I am late.

Senator MALONE. That is all right. Just continue, if you remember where you left off, and we will try to connect up your testimony.

STATEMENT OF W. S. PETERSON—Resumed

Mr. PETERSON. As I recall it, you were interested in whether we could arrange some way to get defense loads singled out. I have been giving that some thought in the interim and I find, as I look back on our own experience where you have defense loads superimposed on other loads from the same consumers that we actually tried to conduct a survey and had some difficulty in separating them all. We have some prospective loads also. It seems to me that the main procedure that could be used is the same as we would use for applying for the right to building a steam plant for power production. You indicate the load in the area and the contribution of this plant toward carrying that load and the Government should find equal rights to build a plant such as the Bridge Canyon plant as for some group in the Los Angeles, Arizona, and Nevada to build a steam plant, presumably to carry that load. I don't believe you would have to distinguish, if this plant is justified because there is just so much defense load there. I believe the idea generally is that it is the intent of both the DEPA and the MPA group to have adequate power in the community. This is a contribution to supplying necessary power and I see no reason why that approach shouldn't be more powerful even than to talk purely about the defense loads as such.

Senator MALONE. Well, Mr. Peterson, I agree with you, but I am not President of the United States, and the President says that we must not continue these developments except on a national defense basis or justified through some connection. As long as he is President and he has said that, that nullifies to a certain extent some of our ideas about going ahead with these developments. Two rivers, five reservoirs that I have had authorized under the Public Works Committee, three reservoirs on the upper Humbolt River in northeastern Nevada, and two reservoirs—you heard the testimony this morning—on the upper Muddy, that in my opinion should qualify, but so far have not qualified through the Bureau of the Budget. So, I know that there would be a difference in opinion as to where national defense begins and where it leaves off, because there is power used in many manufactures and auxiliary products that really are, yet might not be called national defense. I thought we might make a rough estimate. We are using the power for a national defense purpose that we need for domestic and other purposes. That might be an adequate reason for further development. That is the reason I asked you if you would make a stab at it and I knew it would be an estimate based on your own assumptions.

Mr. PETERSON. If that type of estimate were to be made, I think that the problem would be better put to the entire Pacific Coast Interchange Committee, which is a group that has been assembling statistics for power supply purposes, and they have the contacts with all of the groups that are involved that would use power from either one or both of these projects. The same machinery might be used. I think a request from your committee to that group, and we would assist, certainly, to cover the area we are involved in, would produce a better answer. In other words, that committee deals with four groups, roughly four areas. We are the ones responsible for collecting statistics in one portion of that, and would be willing to cooperate to that extent, because that is our field. I think the committee machinery would probably be the one that you could use.

Senator MALONE. Could you give us some idea of the personnel of this committee?

Mr. PETERSON. Mr. Harry A. Lott, of the Southern California Edison Co., is the chairman of that committee.

Senator MALONE. And if we communicated with Mr. Lott you think that that would get results?

Mr. PETERSON. I think that would be an appropriate way to get results.

Senator MALONE. I will suggest to the committee that we do that. Is there any further statement that you would like to make?

Mr. PETERSON. No, I have nothing else to volunteer.

Senator MALONE. Are there any questions of Mr. Peterson? I think that is all, then, Mr. Peterson, and thank you very much.

I read a telegram earlier from Mr. E. A. Thomas, chairman of the Arizona Power Authority, stating that he would be unable to attend but would be represented by K. S. Wingfield, administrator, and Howard Thompson, authority attorney. Since then Mr. Wingfield and Mr. Thompson have arrived. Mr. Wingfield, would you like to come forward and make a statement on behalf of your commission?

Mr. Wingfield, would you identify yourself and your title for the record and introduce your associates that are with you from the Arizona Power Authority?

Mr. WINGFIELD. My name is K. S. Wingfield. I have Mr. Howard Thompson here with me who is an assistant attorney general for the State. I have some other gentlemen here who are not associated directly with the Arizona Power Authority but are from Arizona. Mr. Mansfield is counsel for the Interstate Stream Commission, Mr. Formann is vice president of the Arizona Public Service Co., and Mr. Stanley Ward is manager of the Salt River Power District. Those gentlemen will speak for themselves if you care to call on them.

Senator MALONE. All right, Mr. Wingfield, we would be very glad for you to proceed and make any statement you care to make for the record. You were here this morning when the purposes of this hearing were stated and discussed. You heard the previous testimony.

STATEMENT OF K. S. WINGFIELD, ADMINISTRATOR, ARIZONA POWER AUTHORITY

Mr. WINGFIELD. We had no prepared statement, Senator. We didn't have very much notice in advance of the meeting and didn't have very much time to prepare anything, so that we don't have any statement of that kind. I might say, however, that in principle the Arizona Power Authority is in favor of these projects being developed along the Colorado River but it is in favor of them being developed only as multipurpose projects, taking into consideration the full development of every possible resource to which they can contribute within the area. By that I mean irrigation, flood control, navigation, fish and wildlife, recreation, and all the features that go with a multipurpose project. We also would like to repeat what we have stated in all our other testimonies: That the Bridge Canyon project is wholly contained in the State of Arizona. It represents a natural resource in the State of Arizona and all of our investigations indicate that by the time Bridge Canyon could be developed the State of Arizona will need all of the power that can be developed in Bridge Canyon. In support of that we have filed a formal application with the Secretary of the Interior for all the power from the Bridge Canyon project. I think that briefly states the position of the authority.

Senator MALONE. I think that is very clear. Do you have anything to add to that?

Mr. WINGFIELD. No, sir; not at this time.

Senator MALONE. You would, in this development, I suppose, continue your demand for the total water available for irrigation?

Mr. WINGFIELD. Well, Arizona Power Authority, as an agency of the State, only has to deal with power, but we feel that the project should include all of the features in addition to power, which may be contributed to the area—irrigation and all the water controls that go with the multipurpose project.

Senator MALONE. I think that is the general idea.

Mr. WINGFIELD. As an agency, we don't have anything to do with anything in Arizona except power.

Senator MALONE. There is a certain amount of water that would be necessary for the development of power in any State where it is

necessary. How much water did you utilize out of the Colorado River tributaries in Arizona?

Mr. WINGFIELD. Again you are getting out of my field; as I say, we deal only with the power and we don't deal directly with the water. Any answer I might give you might be a complete approximation guess on my part.

Senator MALONE. I guess it is about 2,800,000 acre-feet out of the tributaries of Colorado altogether; is it not, annually?

Mr. WINGFIELD. I really don't know that.

Senator MALONE. There are 4½ to 5 million acre-feet in California. The State of Nevada now utilizes about seventy to seventy-five thousand acre-feet. I think that is all, then, Mr. Wingfield. If one of your associates would like to supplement your statement, I would be very glad to have them do so.

Mr. WINGFIELD. All right.

Mr. MORRIS. Senator, may I ask a question?

Senator MALONE. Yes; any witness may ask questions. This is very informal, and the idea is to bring out the facts, and if any witness has any objections to anyone asking questions the committee would not insist. I do not suppose that you have any objection.

Mr. WINGFIELD. I have no objections. I just hope I can answer them.

Mr. MORRIS. If the support of a multiple-purpose water project such as Bridge Canyon is to be under the Boulder Canyon Act, do you favor the support of the financing of that project for irrigation features largely from use of the interest component from power revenues, so that the taxpayers of the United States do not receive back any of the interest?

Mr. WINGFIELD. The only thing that I can say to that, Mr. Morris, is that that is the interpretation of the act as it stands now, and I support the act as it is interpreted.

Senator MALONE. Will you please give reference?

Mr. WINGFIELD. The Reclamation Act.

Senator MALONE. Are there any other further questions? If there are no other questions, that will be all, Mr. Wingfield. We appreciate your presence here.

Mr. WINGFIELD. Thank you, sir.

Senator MALONE. Are there any of your associates that would like to be heard?

STATEMENT OF J. D. MANSFIELD, SPECIAL COUNSEL, ARIZONA INTERSTATE STREAM COMMISSION

Mr. MANSFIELD. Mr. Chairman, my name is J. D. Mansfield. I am special counsel for the Arizona Interstate Stream Commission. I feel somewhat of an interloper here today. However, the Arizona Interstate Stream Commission under the laws of the State of Arizona is charged with the obligation and duty of protecting Arizona's interests.

Senator MALONE. Mr. Mansfield, I want you to feel at home. You are perfectly welcome.

Mr. MANSFIELD. I didn't get to finish my thought on that, Mr. Chairman. Our purpose, as I said, in the function of the Inter-

state Stream Commission is the protection of Arizona's interests in the interstate streams of the State, particularly matters affecting irrigation and reclamation. The Arizona Interstate Stream Commission, as such, received no notice of today's meeting. However, 3 days ago we learned informally of the meeting, and I was requested to come to your hearing today with this request: That because of the shortness of time and other commitments of our engineering and legal staff, we have not had an opportunity to prepare a statement or other factual material for presentation to the committee. So, I was instructed to request of the committee an opportunity to be heard upon this particular bill at a later date.

Senator MALONE. I think we have given very little thought to a continuation of the hearing, but we could very well recess at the end so that supplemental reports or statements could be sent in as exhibits, or, if it is a relatively short statement, be made a part of the record.

Mr. MANSFIELD. We would appreciate that opportunity.

Senator MALONE. You will have the opportunity, we will say that now.

Mr. MANSFIELD. Thank you very much.

Senator MALONE. Do you have any further statement?

Mr. MANSFIELD. No, I don't think I have anything else that I could add.

Senator MALONE. I am sorry that we did not notify your Commission. *I had Mr. Smith combing the record for committees and commissions* of the interested States and I thought we had all of them, but some are always overlooked. I am sorry about that.

Mr. MANSFIELD. That is all right. We felt we would be welcome; that is why we came up.

Senator MALONE. Thank you very much. You have another associate here. Would he care to make a statement?

Mr. MANSFIELD. There is no other associate of the Interstate Stream Commission. The other people who are in attendance, Mr. Wingfield told you who they were.

Senator MALONE. Well, thank you very much, Mr. Wingfield. The Colorado River Commission of Nevada is represented here now and I will ask Mr. Jack Buehler to make the opening statement and then he can introduce any member of the staff that he would like to have make a statement.

Mr. Buehler, you are entirely familiar over a long period of time with the work of the Colorado River Commission of Nevada. You were not here this morning when the opening statement was made. The purpose of the hearing is to provide information to the Public Works Committee in January on the opening of the 83d Congress, without delay, and acquaint them with the needs for additional power and water storage, irrigation, in the lower basin area. We have heard Mr. Harvey McPhail, Assistant Reclamation Commissioner, regarding the coordination of the available power and potential power supply, which include, Shasta Dam power and other power that might be secured from future dams in the Central Valley project of California and the potential Bridge Canyon and Glen Canyon power. I know you have had considerable difficulty in your Commission in keeping up with the power needs. Would you make a general statement in

that regard, of the work of your Commission, and introduce any employee of the Commission who would like to make a statement.

Mr. BUEHLER. Senator, the Colorado River Commission of Nevada has sold all of its energy allocated to the State of Nevada from Hoover and Davis Dams, totaling 977 million kilowatt-hours. We are now confronted with an acute shortage of energy in this part of the country. We have a fair start in industrial enterprise with the possibilities of greatly expanding the industrial potentialities of the area but we are short of power. At the present time, I understand we are short approximately 400 million kilowatt-hours of meeting the requirements at the Basic Magnesium plants alone.

Senator MALONE. This statement includes only the contract needs for the power.

Mr. BUEHLER. That includes only the contractors at the, or rather the industries at the Basic Magnesium plant, consisting of five major industries. As those industries grow, obviously, there will be a shortage of energy among the three Nevada contractors. The Southern Nevada Power Co. right now is short of energy. I wouldn't attempt to tell you how many kilowatt-hours they require. Mr. Compton, the manager, is here and he can speak for the Southern Nevada Power Co. To supplement my remarks as to our requirements, I would like to introduce our chief engineer, Jim Shaver, who is very familiar with the requirements and the future needs of the State of Nevada.

Senator MALONE. Thank you, Mr. Buehler. Mr. Shaver will please come forward now and complete the statement for the Nevada Colorado River Commission. You heard the testimony of Mr. Buehler, a member of the Commission, and he suggested that you take over and complete the statement. You may proceed.

STATEMENT OF A. J. SHAVER, CHIEF ENGINEER, COLORADO RIVER COMMISSION OF NEVADA

Mr. SHAVER. Senator, I have no prepared statement here today. Our Commission was in session yesterday and this morning. That accounts for the fact that we were not officially represented here. I did not hear the opening statements made. I am assuming that some discussion was had relative to Bridge and Glen Canyons or other projects on the Colorado River and apparently has been had of the power situation in the entire Southwest. Mr. Buehler stated that we here in southern Nevada immediately face a power shortage. That has been apparent since January 1950 when we allocated all of our Hoover and Davis energy to the various contractors of the State including the original three southern Nevada contractors: Southern Nevada Power Co., Lincoln County Power District, and Overton Power District; and, of course, including the lessees at the Basic project. I can confirm Mr. Buehler's statement that we face, apparently, a shortage of some 350 or 400 million kilowatt-hours annually.

Senator MALONE. How many kilowatts, approximately, would that be under your normal load factor?

Mr. SHAVER. Senator, I hesitate to answer that offhand, because the three southern Nevada contractors' requirements are, of course, computed at a much different load factor than the basic requirements. The overall load factor of the Basic project, I assume, is about 85 percent; the average annual load factor of the Lincoln County Power

District, I believe, is around 80 percent. Overton Power District and Southern Nevada Power Co. operating a more domestic service, operate at an annual average load factor of around 40 or 45 percent. I think it is fair to say that the Southern Nevada Power Co., and Mr. Compton is here, he can confirm or rebut this figure, but I believe it is fair to say that Southern Nevada Power Co. will need, within the next 5 years, 100 million kilowatt-hours in addition to their present firm contract. Overton Power District, being the smallest of the three, will need an additional amount. I am not prepared to say how much. I do not know whether they are represented here today or not. Lincoln County Power District presumably has energy enough to take care of its Lincoln district requirements, but with the advent of a manganese project and process, directly under the Lincoln County Power District at Pioche, I assume additional energy will be needed in that area. The major lessees at the Basic project all have firm contracts with the Colorado River Commission totaling at present 622 million kilowatt-hours a year. With the expanded program brought on through the defense agency, either by prime contract or secondary contract, it appears as of this date we are 145 million kilowatt-hours short in the present operating year. This does not disturb us particularly at this time because we feel we are able to pick that up through excess waters at Davis power plant. This being in the laps of the gods a good water year for the Colorado River projects, the years of 1953–54 and subsequent thereto do give us some concern. It appears that in the years 1953–54, we will have to purchase about 350 million kilowatt-hours for the operating year. That figure remains with us from 1954 on except that very recently we have been presented with requests for still additional supplies of energy to the major lessees of the Basic project. We have at hand a request immediately, to be made available next August 1, for 125 million kilowatt-hours a year. One of the other lessees wishes to increase his firm contract from 232 to 370 million kilowatt-hours a year. The other three have expressed a need for increased energy. The State of Nevada, Colorado River Commission, at present is negotiating with agencies in southern California and with utilities in Arizona through which we hope to obtain some of this additional energy, if not all.

Senator MALONE. That would be a temporary expedient, would it not?

Mr. SHAVER. That I would presume, Senator, would be delivered on what you would term an "if and when" basis. We must rely, in the absence of other generating sources strictly for the State of Nevada, we must rely on outside sources to develop this energy and capacity for us. A great deal of attention is being given to the consideration of steam at the present time by the State of Nevada. Our interest has been, of course, centered in Glen and Bridge Canyon projects. As long as three years ago the State of Nevada made a direct request to the Secretary of the Interior for an equitable share of the output of any and all installations in the lower basin on the Colorado River. Our request is still before the Secretary of the Interior. I feel we are being considered, to what extent, remains to be seen. I do believe, and this was repeated this morning in our commission meeting, it is my sincere belief that the State of Nevada or its contractors, the State not being in a position of building steam facilities, not being authorized by its commission law to enter into the

utility field to that extent, I firmly feel that the time is fast approaching when the major users of Nevada's power must look to a source of energy of their own. It would appear at this time that steam is the only other source of supply.

Senator MALONE. What would be the source of fuel for this steam power?

Mr. SHAVER. We have considered coal from Utah. We have given some thought to gas if it can be obtained in sufficient quantities with the installation of the proposed gas line in the Henderson-Vegas area. Oil, of course, you are familiar with the oil costs in the State of Nevada. We would be immediately faced with 50 to 60 percent increase in operating costs over the same comparable figure in southern California due to the freight rate on oil. I think possibly I could answer your questions. I don't know if there is any other statement I should make at this time, except to say, we have a contract on our desk through which we hope to obtain off-peak energy. I would state at this time that the State of Nevada has requested the installation of unit N–8 in the Hoover power plant for peaking purposes, standby purposes, and in an effort to make this off-peak energy available to us by taking our Hoover waters over a shorter period of time per day, per week, per month, per year. You know, we have also signed a contract for Shasta energy. We are hopeful, within the next few weeks, of entering into contracts with some southern California agencies through which we hope to obtain still an additional supply of energy. If these contracts are signed, Nevada is not in a bad position, except for firm energy. It is my sincere belief in order to firm this outside purchased energy we should seriously consider the erection of a steam plant.

Senator MALONE. Could I ask at this point if the Colorado River Commission has communicated with the power companies in California who potentially could transfer-wheel and transfer the power to this area?

Mr. SHAVER. Which power, Senator?

Senator MALONE. Shasta.

Mr. SHAVER. The Governor, as chairman of the Colorado River Commission, is making appointments with the Pacific Gas & Electric Co. and the Southern California Edison Co.

Senator MALONE. They have not communicated with them officially, they are going to meet with them?

Mr. SHAVER. I can't answer that.

Senator MALONE. What would be the average amount of power, average amount of kilowatt-hours annually that would be necessary, adding up all the additional amounts of power that you mentioned for the various users, just in round numbers?

Mr. SHAVER. I haven't my tabulation with me, Senator, but if I remember the figures correctly, our needs increasing at the rate of 5 percent annually from the present date up to 1960, our requirements in 1960 would be approximately 1,400,000,000 kilowatt-hours. Now, if we acknowledge these additional requests which have come to us, and we must acknowledge them, and we are making every effort to obtain the energy, I would assume that figure instead of being 1.4 billion would be as high as 1.7 billion in 1960.

Senator MALONE. That is the total figure, including what you are now using, or the increment that you need?

Mr. SHAVER. That is the total we would need. In other words, we expect to increase from 977 million, approximately, to 1.6 billion or 1.7 billion annually by 1960. I am giving you these figures from memory.

Senator MALONE. It would be helpful to take your time and prepare a table and submit it for the record.

(The tabulation referred to follows:)

COLORADO RIVER COMMISSION OF NEVADA,
Henderson, Nev., November 6, 1952.

Hon. GEORGE W. MALONE,
United States Senator from Nevada,
Senate Office Building, Washington, D. C.

DEAR SENATOR GEORGE: Here is a tabulation showing power requirements and availability in detail for the next 3 operating years, and tabulation of projected study of the Colorado River Commission through 1960.

I trust you will find these interesting and enlightening, and I hope they give you the information you need for inclusion in your hearings.

If I can send you further information, please be sure to call on me for it.

With kind personal regards.

Cordially,

A. J. SHAVER.

State of Nevada estimated power requirements

[Operating years 1952–53, 1953–54, 1954–55 revised and effective Oct. 15, 1952]

Contractors	1952–53		1953–54		1954–55	
	Million watts	Million kilowatt-hours	Million watts	Million kilowatt-hours	Million watts	Million kilowatt-hours
Basic contractors:						
Requirements	[1] 118.9	586.89	127.5	852.64	128.2	893.16
Available	[2] 86.0	[3] 501.00	94.5	[3] 561.50	103.0	622.00
Over/short	−32.9	−85.89	−33.0	−291.14	−25.2	−271.16
Southern Nevada contractors:						
Requirements	[1] 106.0	378.31	122.1	436.31	138.6	488.36
Available	[2] 87.0	319.10	87.0	332.60	87.0	316.10
Over/short	−19.0	−59.21	−35.1	−103.71	−51.6	−142.26
Total State contractors:						
Requirements	[1] 224.9	965.20	249.6	1,288.95	266.8	1,381.52
Available	[2] 173.0	820.10	181.5	894.10	190.0	968.10
Over/short	−51.9	−145.10	−68.1	−394.85	−76.8	−413.42
State of Nevada:						
Requirements (see above)	224.9	965.20	249.6	1,288.95	266.8	1,381.52
Availability (actual)	199.5	[4] 833.36	199.5	954.60	199.5	968.10
Over/short	−25.4	−131.84	−50.1	−334.35	−67.3	−413.42

[1] All demand requirements are as each contractor requires it. It is not a simultaneous peak.

[2] All demand availability is based on contracts with each basic contractor. Southern Nevada contractors demand availability is based on 15 million watts from N–7, 50 million watts from A–9, and 22 million watts from bank Y and split as follows: Southern Nevada Power Co., 83.35 percent; Lincoln County Power District, 13.30 percent; and Overton Power District, 3.35 percent. Basic contractors have 67.5 million watts from N–7 and 45 million watts from Davis; total, 112.5 million watts. State total from Hoover and Davis, 199.5 million watts.

[3] See detail on basic contractor breakdown sheet.

[4] 803.36 million kilowatt-hours available to State of Nevada from Hoover and Davis as per contracts. 30 million kilowatt-hours Davis dump purchased for Southern Nevada Power Co. during June, July, and August.

Basic contractors estimated power requirements

[Operating years 1952–53, 1953–54, 1954–55 revised and effective Oct. 15, 1952]

Contractors	1952–53		1953–54		1954–55	
	Million watts	Million kilowatt-hours	Million watts	Million kilowatt-hours	Million watts	Million kilowatt-hours
Basic Management, Inc.:						
Requirements	5.7	22.45	5.0	24.25	5.7	25.65
Available	3.8	12.00	3.8	12.00	3.8	12.00
Over/short	−1.9	−10.45	−1.2	−12.25	−1.9	−13.65
Cal-Pacific Utility Co.:						
Requirements	12.8	30.10	14.1	34.35	14.1	36.00
Available	10.0	20.00	10.0	20.00	10.0	20.00
Over/short	−2.8	−10.10	−4.1	−14.35	−4.1	−16.00
Combined Metals Reduction Co.:						
Requirements	12.5	36.54	22.7	131.96	22.7	169.43
Available	8.0	58.00	8.0	58.00	8.0	58.00
Over/short	−4.5	+21.46	−14.7	−73.96	−14.7	−111.43
Manganese, Inc.[1]						
Requirements	2.8	11.25	2.8	17.40	2.8	17.40
Available	2.8	6.00	2.8	6.00	2.8	6.00
Over/short	0	−5.25	0	−11.40	0	−11.40
National Lead Co.:						
Requirements	23.2	103.04	21.0	157.44	21.0	157.44
Available	4.0	30.00	12.5	90.50	21.0	151.00
Over/short	−19.2	−73.04	−8.5	−66.94	0	−6.44
Stauffer Chemical Co.:						
Requirements	28.7	[1] 178.17	28.7	226.00	28.7	226.00
Available	19.9	139.00	19.9	139.00	19.9	139.00
Over/short	−8.8	−39.17	−8.8	−87.00	−8.8	−87.00
U. S. Lime Products Co.:						
Requirements	.6	3.79	.6	4.44	.6	4.44
Available	.5	4.00	.5	4.00	.5	4.00
Over/short	−.1	+.21	−.1	−4.4	−.1	−.44
Western Electrochemical Co.:						
Requirements	32.6	201.55	32.6	256.80	32.6	256.80
Available	37.0	232.00	37.0	232.00	27.0	232.00
Over/short	+4.4	+30.45	+4.4	−24.80	+4.4	−24.80
Total Basic Contractors:						
Requirements	[2] 118.9	586.89	[2] 127.5	852.64	[2] 128.2	893.16
Available	[3] 86.0	[4] 501.00	[3] 94.5	[5] 561.50	[3] 103.0	[5] 622.00
Over/short	−32.9	−85.89	−33.0	−291.14	−25.2	−271.16

[1] Includes Hercules for June and July, 1952.
[2] This peak is a total of each contractor's demand as needed but it is not a simultaneous peak.
[3] Kilowatts available to basic contractors as per contracts. Kilowatts available to State of Nevada equals 112,500 (Hoover, 67,500; Davis, 45,000; total, 112,500).
[4] Kilowatt-hours sold to basic contractors as per contracts. This is 16,745,000 kilowatt-hours more than State of Nevada's allotment from Hoover and Davis (Hoover, 248,255,000; Davis, 236,000,000; total, 484,255,000).
[5] Kilowatt-hours sold to basic contractors as per contracts. State of Nevada allotment equals: Hoover, 386,000,000; Davis, 236,000,000; total 622,000,000.

Southern Nevada contractor's estimated power requirements

[Operating years 1952–53, 1953–54, 1954–55, revised and effective Oct. 15, 1952]

Contractors	1952–53		1953–54		1954–55	
	Million watts	Million kilowatt-hours	Million watts	Million kilowatt-hours	Million watts	Million kilowatt-hours
Lincoln County Power District:						
Requirements	8.0	68.00	10.0	80.02	10.0	80.02
Available	11.5	80.00	11.5	80.00	11.5	80.00
Over/short	+3.5	+12.00	+1.5	−.02	+1.5	−.02
Overton Power District:						
Requirements	2.5	10.20	2.8	11.15	2.9	11.40
Available	3.0	10.50	3.0	11.00	3.0	11.50
Over/short	+.5	+.30	+.2	−.15	+.1	+.10
Southern Nevada Power Co.:						
Requirements	95.5	300.11	109.3	345.14	125.7	396.94
Available	[1] 72.5	228.60	[1] 72.5	241.60	[1] 72.5	254.60
Over/short	−23.0	−71.51	−36.8	−103.54	−53.2	−142.34
Total Southern Nevada Contractor:						
Requirements	[2] 106.0	378.31	[2] 122.1	436.31	[2] 138.6	488.36
Available	87.0	319.10	87.0	332.60	87.0	346.10
Over/short	−19.0	−59.21	−35.1	−103.71	−51.6	−142.26

[1] Does not include 10,000,000 watts available to Southern Nevada Power Co. in the winter months from Arizona This capacity is not firm.

[2] This demand is a total of all contractors demands as needed but it is not a simultaneous peak.

Estimated power requirements, operating years 1952–53, 1953–54, 1954–55

	Basic Contractors		Southern Nevada Contractors		Total	
	Million watts	Million kilowatt-hours	Million watts	Million kilowatt-hours	Million watts	Million kilowatt-hours
1952—June	51.8	32.34	35.3	19.28	87.1	51.62
July	59.2	35.75	41.7	21.96	100.9	57.71
August	54.9	34.48	41.0	22.82	95.9	57.30
September	59.1	33.64	39.3	20.27	98.4	53.91
October	60.2	35.61	52.5	25.66	112.7	61.27
November	76.7	43.54	69.0	37.76	145.7	81.30
December	87.3	50.73	104.9	50.16	192.2	100.89
1953—January	99.9	69.46	[1] 105.5	59.31	[1] 205.4	114.77
February	99.4	58.38	85.5	37.96	184.9	96.34
March	105.4	64.44	80.0	34.81	185.4	99.25
April	[1] 108.7	67.15	54.1	27.66	162.8	94.81
May	108.5	68.37	47.7	27.66	156.2	96.03
Total operating year		586.89		378.31		965.20
1953—June	110.4	68.13	40.0	24.55	150.4	92.68
July	109.6	60.36	47.7	27.58	157.3	96.94
August	109.6	69.51	47.1	28.63	156.7	98.14
September	109.8	68.03	45.7	26.37	155.5	94.40
October	113.9	69.36	61.2	28.41	175.1	97.77
November	115.7	69.58	79.1	42.36	194.8	111.94
December	116.5	71.88	121.0	56.56	237.5	128.44
1954—January	117.6	72.03	[1] 122.1	58.86	[1] 239.7	130.89
February	124.3	72.42	98.1	42.66	222.4	115.08
March	[1] 125.8	75.55	90.7	38.91	216.5	114.46
April	120.0	72.71	60.9	30.71	180.9	103.42
May	120.0	74.08	53.8	30.71	173.8	104.79
Total operating year		852.64		436.31		1,288.95
1954—June	118.8	73.07	45.1	27.28	163.9	100.35
July	117.9	74.46	53.8	30.70	171.7	105.16
August	117.9	74.62	53.1	31.95	171.0	106.57
September	118.1	72.95	52.4	29.28	170.5	102.23
October	112.7	74.50	69.0	31.52	181.7	106.02
November	124.7	74.72	89.6	47.54	214.3	122.26
December	[1] 125.6	77.31	137.6	63.91	263.2	141.22
1955—January	125.1	76.77	[1] 138.5	66.45	[1] 263.6	143.22
February	124.3	72.42	111.0	47.84	235.3	120.26
March	124.8	75.55	102.8	43.57	227.6	119.12
April	120.0	72.71	68.6	34.16	188.6	106.87
May	120.0	74.08	60.7	34.16	180.7	108.24
Total operating year		893.16		488.36		1,381.52

[1] Peak demand.

SCHEDULE A.—*Estimated power use, 1952–60—Revised and effective Oct. 15, 1952*

[Operating years]

Month	Million watts	Million kilowatt-hours	Million watts	Million kilowatt-hours	Million watts	Million kilowatt-hours	Million watts	Million kilowatt-hours
	1952–53		1953–54		1954–55		1955–56	
June	[2] 87.1	[1] 51.62	150.4	92.68	163.9	100.35	188.5	115.40
July	[1] 100.9	[1] 57.71	157.3	96.94	171.7	105.16	197.5	120.93
August	[1] 95.9	[1] 57.30	156.7	98.14	171.0	106.57	196.7	122.56
September	[1] 98.4	[1] 53.91	155.5	94.40	170.5	102.23	196.1	117.56
October	[2] 112.7	[2] 61.27	175.1	97.77	181.7	106.02	208.1	121.92
November	[2] 145.7	[2] 81.30	194.8	111.94	214.3	122.26	246.4	140.60
December	192.2	100.89	237.5	128.44	263.2	141.22	302.7	162.40
January	205.4	114.77	239.7	130.89	263.6	143.22	303.1	164.70
February	184.9	96.34	222.4	115.08	235.3	120.26	270.6	138.30
March	185.4	99.25	216.5	114.46	227.6	119.12	262.7	136.99
April	152.8	94.81	180.9	103.42	188.6	106.87	216.9	122.90
May	156.2	96.03	173.8	104.79	180.7	108.24	207.8	124.48
Total		965.20		1,288.95		1,381.52		1,588.74
	1956–57		1957–58		1958–59		1959–60	
June	216.8	132.71	249.3	152.62	286.7	175.51	329.7	201.84
July	227.1	139.07	261.2	159.93	300.4	183.92	345.5	211.51
August	226.2	140.94	260.1	162.08	299.1	186.39	344.0	214.35
September	225.5	135.19	259.3	155.47	298.2	178.79	342.9	205.60
October	239.3	140.21	275.2	161.24	316.5	185.43	364.0	213.24
November	283.4	161.69	325.9	185.94	374.8	213.83	431.0	245.90
December	348.1	186.76	400.3	214.77	460.3	246.99	529.3	284.04
January	348.6	189.41	400.9	217.82	461.0	250.49	530.1	288.06
February	311.2	159.05	357.9	182.91	411.6	210.35	473.3	241.90
March	302.1	157.54	347.4	181.17	399.5	208.35	459.4	239.60
April	249.4	141.34	286.8	162.54	329.8	186.92	379.3	214.96
May	239.0	143.15	274.8	164.62	316.0	189.31	363.4	217.71
Total		1,827.06		2,101.11		2,416.28		2,778.71

[1] Actual use.
[2] Latest confractors' estimates.

NOTE.—This estimate is based on the following: The years of 1952, 1953 and 1954 are all contractors' estimates. The balance of the years are increased 15 percent each year over the 1954–55 total.

SCHEDULE B.—*Estimated power use, 1952–60—Revised and effective Oct. 15, 1952*

[Operating years]

Month	Million watts	Million kilowatt-hours	Million watts	Million kilowatt-hours	Million watts	Million kilowatt-hours	Million watts	Million kilowatt-hours
	1952–53		1953–54		1954–55		1955–56	
June	[1] 87.1	[1] 51.62	150.4	92.68	163.9	100.35	180.3	110.39
July	[1] 100.9	[1] 57.71	157.3	96.94	171.7	105.16	188.9	115.68
August	[1] 95.9	[1] 57.30	156.7	98.14	171.0	106.57	188.1	117.23
September	[1] 98.4	[1] 53.91	155.5	94.40	170.5	102.23	187.6	112.45
October	[2] 112.7	[2] 61.27	175.1	97.77	181.7	106.02	199.9	116.62
November	[2] 145.7	[2] 81.30	194.8	111.94	214.3	122.26	235.7	134.49
December	192.2	100.89	237.5	128.44	263.2	141.22	289.5	155.34
January	205.4	114.77	239.7	130.89	263.6	143.22	290.0	157.54
February	184.9	96.34	222.4	115.08	235.3	120.26	258.8	132.29
March	185.4	99.25	216.5	114.46	227.6	119.12	250.4	131.03
April	162.8	94.81	180.9	103.42	188.6	106.87	207.5	117.56
May	156.2	96.03	173.8	104.79	180.7	108.24	198.8	119.06
Total		965.20		1,288.95		1,381.52		1,519.68
	1956–57		1957–58		1958–59		1959–60	
June	198.3	121.43	218.1	133.57	239.9	146.93	263.9	161.62
July	207.8	127.25	228.6	139.98	251.5	153.98	276.7	169.38
August	206.9	128.95	227.6	141.85	250.4	156.04	275.4	171.64
September	206.4	123.70	227.0	136.07	249.7	149.68	274.7	164.65
October	219.9	128.28	214.9	141.11	236.4	155.22	260.0	170.74
November	259.3	147.94	285.2	162.73	313.7	179.00	345.1	196.90
December	318.5	170.87	350.4	187.96	385.4	206.76	423.9	227.44
January	319.0	173.29	350.9	190.62	386.0	209.68	424.6	230.65
February	284.7	145.52	273.6	160.07	301.0	176.08	351.1	193.69
March	275.4	144.13	302.9	158.54	331.2	174.39	364.5	191.83
April	228.3	129.32	251.1	142.25	276.2	156.48	303.8	172.13
May	218.7	130.97	240.6	144.07	264.7	158.48	391.2	174.33
Total		1,671.65		1,538.82		1,692.70		1,861.97

[1] Actual use.
[2] Latest contractors' estimate.

NOTE.—This estimate is based on the following: The years of 1952, 1953, and 1954 are the contractors' estimates. The balance of the years are increased 10 percent each year over the 1954–55 total.

SCHEDULE C.—*Estimated power use, 1952–60—Revised and effective Oct. 15, 1952*

[Operating years]

Month	Operating Years							
	1952–53		1953–54		1954–55		1955–56	
	Million watts	Million kilowatt-hours	Million watts	Million kilowatt-hours	Million watts	Million kilowatt-hours	Million watts	Million kilowatt-hours
June	[1] 87.1	[1] 51.62	150.4	92.68	163.9	100.35	170.7	104.44
July	[1] 100.9	[1] 57.71	157.3	96.94	171.7	105.16	179.8	109.76
August	[1] 95.9	[1] 57.30	156.7	98.14	171.0	106.57	179.0	111.36
September	[1] 98.4	[1] 53.91	155.5	94.40	170.5	102.23	178.4	106.62
October	[2] 112.7	[2] 61.27	175.1	97.77	181.7	106.02	210.1	110.75
November	[2] 145.7	[2] 81.30	194.8	111.94	214.3	122.26	227.7	129.39
December	192.9	100.89	237.5	128.44	263.2	141.22	283.8	150.81
January	205.4	114.77	239.7	130.89	263.6	143.22	284.4	153.19
February	184.9	96.34	222.4	115.09	235.3	120.26	252.0	127.02
March	185.4	99.25	216.5	114.46	227.6	119.12	243.0	125.65
April	162.8	94.81	180.9	103.42	188.6	106.87	198.9	111.99
May	156.2	96.03	173.8	104.79	180.7	108.24	189.8	113.36
Total		965.20		1,288.95		1,381.52		1,454.34
	1956–57		1957–58		1958–59		1959–60	
June	178.4	109.15	187.4	114.56	197.7	120.78	209.5	127.94
July	189.1	115.06	199.7	121.15	212.0	128.15	226.1	136.21
August	188.1	116.87	198.7	123.21	210.8	130.50	224.7	138.88
September	187.4	111.67	197.8	117.48	209.7	124.16	223.5	131.84
October	204.0	116.17	217.6	122.44	233.4	129.63	251.5	137.90
November	243.2	137.59	261.0	147.02	281.4	157.87	304.9	170.34
December	307.6	161.83	334.9	174.51	366.3	189.09	402.4	205.86
January	308.3	164.65	334.7	177.83	367.3	192.99	403.7	210.42
February	271.1	135.69	293.1	145.18	318.4	156.09	347.6	168.64
March	260.8	133.17	281.1	141.81	304.6	151.75	331.6	163.18
April	210.7	117.89	224.3	124.66	240.0	132.46	258.0	141.42
May	200.3	119.26	212.3	126.03	226.2	133.83	242.1	142.79
Total		1,422.83		1,635.88		1,747.20		1,875.42

[1] Actual use.
[2] Latest contractors' estimate.

NOTE.—This estimate is based on the following: The years of 1952, 1953, and 1954 are the contractors' estimates. The balance of the years are increased 15 percent for each year for the southern Nevada contractors only. BMP estimate is carried on through, without a yearly increase.

Mr. SHAVER. The table is prepared, and I will be glad to send you a copy. As a matter of fact, Senator, to show you how this picture moves, our tabulation was compiled by our load scheduling force on September 15, which is to be compiled for presentation at two meetings we have already had this week, and I find yesterday figures submitted to us which still will change that even further. At all times it is an increasing figure, never are we faced with a decreasing figure.

Senator MALONE. What would this 1,400,000,000 kilowatt-hours mean roughly in kilowatts, just a rough estimate?

Mr. SHAVER. As I say, it is hard to answer that offhand; I would have to give you that from our tabulation. We have it.

Senator MALONE. What is the difference in load factor?

Mr. SHAVER. The difference in load factors between the various users.

Senator MALONE. Would it be 150,000 or——

Mr. SHAVER. Oh no, it is a matter of 250,000 or something like that. I am giving that figure offhand, Senator.

Senator MALONE. It is a fact, isn't it, Mr. Shaver, that the last several years—I might say the last couple of decades—that very few

estimates in the use of power in any area where the cost is held down to a reasonable price that would make chemical and electrical industries feasible, that the estimates have always been under the actual required power when the time comes?

Mr. SHAVER. Senator, I might answer that by saying that most utilities try to draw their load curves and their load growth studies in a reasonable conservative manner, because it is the stockholders or the public's money that they are spending, and it is only just that they should approach the figure in that manner. I think possibly the Colorado River Commission, in good faith, made our load studies on just some such basis, but since 1950, particularly in the case of the Colorado River Commission and the takeover of the Basic project, the unprecedented growth of these particular industries here changed the picture much more rapidly than you would have normally expected it to have been changed. It has thrown us in a tailspin. I think this same situation holds true for the entire Southwest.

Senator MALONE. I think that is true, Mr. Shaver. I remember when we were preparing estimates for the Secretary of the Interior in 1928 and 1929, estimating the potential use in this area at a given time, I think I said at that time, it is a matter of record, that we could use 187,500 horsepower within 20 years, if given access to the power and, further, that we could use around 480,000 horsepower within a reasonable time following that date. Of course, there was considerable guessing at that time because there was no power used at all in this area, that is, almost no power at all. That was assuming that we could hold the price of power at a cost that could be utilized by these chemical and electrical-chemical industries, which are the types of industry that you are now getting in. I have noticed the power-requirements survey over the years, and I think it is important to be cognizant of the fact that it is always underestimated. In view of that fact, we do have potential developments here that should be considered. Do you have any breakdown of the amount of power that these industries now in the area are using, the amount of power and the potential use?

Mr. SHAVER. Yes; that is in our tabulations, Senator.

Senator MALONE. You, of course, from memory, couldn't give us any idea of that use?

Mr. SHAVER. Yes, sir; I think I am familiar enough with these figures. I sleep with them night and day; I can count every kilowatt-hour.

Senator MALONE. You can do that for the record and then submit the tabulations.

Mr. SHAVER. I can give you the amount of kilowatt-hours in the firm contracts of each one of our lessees and contractors. Starting with the original 3, the Overton Power District, subject to some current withdrawals, expects to obtain 12 million kilowatt-hours a year. Lincoln County Power District's withdrawals have been completed with a total of 80 million kilowatt-hours a year. Southern Nevada Power Co., when its withdrawals are completed, will take 263 million kilowatt-hours a year. Just as a diversion of this subject, I might state that Overton Power District in its first year, I believe, took 500,000 kilowatt-hours as their first withdrawal, now it is 12 million. Lincoln County Power District started out, Mr. Buehler can confirm this, with

4 million kilowatt-hours a year. That has grown to 80 million. Southern Nevada Power Co.'s first withdrawal was something like 2½ to 3 million, that has grown to 263 million. You can see the unprecedented growth in the original three. Now with the State taking over the Basic project and these industrial establishments being created here, we have allocated all of the remaining Davis and Hoover energy to those projects.

Senator MALONE. How many of these industries were here when the State took over the project?

Mr. SHAVER. Two major ones, and several small ones, some of which have passed out of existence, some still remain with us. I will refer to these industries by numbers only, I will not repeat the names due to the competitive nature of their products. I think it would be unfair for me in a public statement to give these names. Let us say industry No. 1 whose firm contract is 139 million, last year used some 70 million in excess of their firm contract. That was supplied by the Colorado River Commission of Nevada. We are attempting to enter into a reasonable firm contract with an outside agency through which we expect to obtain 88 million annually in addition to the firm contract of 139 million. They have submitted to us an additional request of 44 million annually in addition to their 88. That would raise their total take from 139 million to 139 plus 132.

Senator MALONE. This outside agency, would that be a firm contract or only an interim agreement?

Mr. SHAVER. The proposal we have on our desk is an offpeak contract.

Senator MALONE. In other words, subject to cancellation on need or how is it?

Mr. SHAVER. It is a ten-year contract, Senator, but it is subject to use by the providing utility.

Senator MALONE. Subject to diminution in accordance, with their need.

Mr. SHAVER. Yes, sir. The second lessee I might speak of, this year has a contract for 30 million kilowatt-hours. Circumstances due to the Defense Department of the United States, let us say, has increased their take to something like 80 million this year, with the expectancy that they will begin to take at the rate of one hundred seventy-odd million the next operating year. We have an additional request from that same agency of 125 million kilowatt-hours a year on top of that, with the possibility of still further growth. The third agency whose contract with us is for 58 million kilowatt-hours a year, expects to obtain from sources of its own, 17½ million, and we have a request for us to raise the total to 93 million annually with that being subject to an increased figure. One of the smaller lessees who is operating here on a pretty consistant basis is pretty happy with a small 4 million kilowatt-hours a year, subject to some slight increment. The other major lessee, a portion of whose output is dedicated, let us say to the war effort, whose firm contract is 232 kilowatt-hours a year expects within a year to be using this at the rate of 370 million kilowatt-hours a year. Now if our figures are anywhere near being correct, and that is outside the increased requirements of the original three contractors, Southern Nevada Power Co., Lincoln, and Overton, and that does not include the energy we must make available to the

California-Pacific Utilities Co., which supplies the town of Henderson, and does not include the additional energy which will be required for pumping, if and when the Las Vegas Valley Water District pump water through the present Basic metals industries facilities. That briefly is the picture. It gives you an idea of the increased pressure put on the Colorado River Commission in its search for additional energy and capacity.

Senator MALONE. Mr. Shaver, how much of this additional power that has been contracted for through the commission is "if and when" power?

Mr. SHAVER. My only answer to that at this time, Senator, is the contract on our desk, which we hope is ready for signature, which will provide, we trust, a minimum of 150 million kilowatt-hours a year with the possibility of that going to 250 or 300 million.

Senator MALONE. And that all would be "if and when" power?

Mr. SHAVER. I think so.

Senator MALONE. In other words, the commission desperately needs now a further source of power that it could retain on its own account?

Mr. SHAVER. I can shorten that by answering that the Colorado River Commission and its lessees desperately need a firm energy contract.

Senator MALONE. Where would the source of this contract be?

Mr. SHAVER. A steam plant.

Senator MALONE. Did you ever consider further power from the Central Valley project and its further development in upstream storage?

Mr. SHAVER. Yes, sir; but I am of the opinion that you don't firm hydro power with additional hydroplants on the same stem of the stream. We do hope to get a reasonable share of Bridge and Glen Canyon projects which comes to us on a firm basis, but that is in the future.

Senator MALONE. This power to firm this other power, is that what your steam power would be for?

Mr. SHAVER. Yes sir, partially, and partially to take care of a base load.

Senator MALONE. Is it possible to have more than one source through more than one transmission line?

Mr. SHAVER. You mean from outside sources?

Senator MALONE. Yes.

Mr. SHAVER. Yes, these sources we are seeking to be supplied through now come, or will come eventually from three different sources, if the deal is consummated.

Senator MALONE. This is the "if and when" power?

Mr. SHAVER. Yes, and including Shasta.

Senator MALONE. That would not be in that category, would it?

Mr. SHAVER. Which category?

Senator MALONE. "If and when," it would be a firm contract.

Mr. SHAVER. Well, Senator Malone, we might have a difference of opinion on that, I think if you review the Shasta contract, it is given to us on a load-factor basis, strictly, and the load factors, the delivery of energy per acre-foot of water varies from winter to summer months, and you will find it is necessary for the State of Nevada under the terms of the contract to arrange for the wheeling and the firming

of the energy. So, it appears to me at this time that we must firm Shasta the same as we must firm other offpeak energy.

Senator MALONE. You are familiar with the fact that power companies have testified many times that they either have or will construct the necessary steam power to firm the Central Valley power. Are you familar with that testimony?

Mr. SHAVER. No sir, I am not.

Senator MALONE. Well, I am now, for the benefit of the record, stating that that is a fact. So, if they go through with that statement I think it would relieve the Nevada commission of some responsibility and if they don't go through with it perhaps there would be better ways of arranging it. I had understood, I have not thoroughly read the contract that the Colorado River Commission signed, but I understood that not only the 33,000 kilowatts were available to us on the basis of permanent, and constant supply, that it was our power and whatever firming it needs could be done by the proposed Tracy steam plants. The Bureau of Reclamation has loaned me one of the bills that has met with a very approved reception on the Senate floor, because of the testimony of the Pacific Gas & Electric Co. that they either have sufficient steam power to firm this energy or will build needed plants. You are not familar with that testimony or the understanding, but that is the situation. Are you familar with the fact that more power will come in on the Folsom Dam in 1954 and probably under the same conditions, and that with a precedent set it will be available to you here?

Mr. SHAVER. I think, Senator, if you will recall, our original application to Shasta was for 90,0000 kilowatts. That was amended last December to 90,000 kilowatts from Shasta and 60,000 from Folsom if and when it was constructed. The State of Nevada is on record as requesting 150,000 kilowatts from the Central Valley project.

Mr. MALONE. I am particularly familar with that, because I have insisted on it from the beginning. I was consulting engineer on that project and finally we did apply for it. Are we counting on following through on that application?

Mr. SHAVER. Certainly.

Senator MALONE. What would be the source of fuel as far as standby power here, would it be the potential gas available to the State?

Mr. SHAVER. That is one premise we are working on, the other is, as I say, Utah coal.

Senator MALONE. What do you estimate the cost would be per kilowatt-hour on the plants with the Utah coal?

Mr. SHAVER. I can't answer that because I haven't a quotation on Utah coal, and I don't know the freight rate. Our estimates are very preliminary.

Senator MALONE. Would it be within the range of 6 or 7 or 8 mills per kilowatt-hour?

Mr. SHAVER. I think, and this is my own personal opinion, I believe if we could get 6-mill energy from either of these fuel sources for southern Nevada it would be as hopeful a figure as we could look forward to.

Senator MALONE. What would be, has there been any projected need for power over 5 to 10 years ahead?

Mr. SHAVER. For this area, yes. Our curves have already been extended to 1960.

Senator MALONE. That was the figure that you gave a while ago of 250,000 kilowatts?

Mr. SHAVER. Yes, that was the figure I gave a while ago of 1,400,000,000 kilowatt-hours.

Senator MALONE. Do you have any further statement?

Mr. SHAVER. No.

Senator MALONE. Are there any questions? I guess that will be all. Thank you. Is Mr. Rollin Smith here? Mr. Smith, would you like to take the stand now? Mr. Smith, I am sorry that you couldn't be present this morning, but the general purpose of this hearing held by the Public Works Committee of the Senate is to determine, as near as may be the sources of power over the years ahead in this area with special reference to national defense and to make available for record in this manner not only the power that is now available through Hoover Dam and Davis Dam and the Shasta Dam power that has already been contracted for, but also looking ahead to further withdrawals from the Central Valley project and the Folsom Dam, when it will be ready in 1954 with 170,000 kilowatts. Under the precedent set, perhaps we could get our share from that source. As to the Bridge Canyon Dam and the Glen Canyon projects, take Bridge Canyon, you are familar with the fact that we do have a bill in the Senate to construct this project which is around 750,000 kilowatts. The Glen Canyon, no bill has been introduced, but it has been brought out that it is needed to coordinate and provide the most efficient use of the Colorado River water and the generation of power, perhaps around 800,000 kilowatts instead of horsepower in this case, available there. The purpose of this hearing is to provide the Public Works Committee with the necessary information when it convenes in January, of the potential demand, not only at this time but over the years ahead, with the idea that national-defense work and this regular peacetime production, that companies engaged in such work may feel safe in making their investments and feel reasonably sure they will have the power they need when the time comes. Now you have one of the most important production plants in the area, as a matter of fact, in the United States of America, for one very important kind of material, and any information that you can provide the committee as to your actual and potential needs over a reasonable number of years ahead would be very helpful to the committee.

STATEMENT OF ROLLIN SMITH, GENERAL MANAGER, TITANIUM METALS CORP., HENDERSON, NEV.

Mr. SMITH. Well, the Titanium Metals Corp. has here the largest single and the only fully integrated operation of producing titanium metal ingots from ore, the ores of titanium. Our present firm program calls for 10 tons per day of titanium and that requires about 15 kilowatt-hours per pound, exclusive of the chlorine makeup, which we get from our neighbor, Stauffer Chemical Co. We have 151 million kilowatt-hours of firm energy contracted for from the Colorado River Commission and have a request before Governor Russell and the Colorado River Commission for an additional 125 million kilowatt-hours a year. In order to carry out a projected expansion which takes us up to about 2½ times our required program, that would bring our re-

quirement up to about 275 million kilowatt-hours a year. As I say, we have 151 million kilowatt-hours of that, we have a firm request of 125 to take and pay for the rest of it. We are also contemplating an additional expansion which would require 175 million to take us up to about 450 million kilowatt-hours a year. The big advantage to us and to the Department of Defense which ultimately gets most of this material is that by expanding here at the Basic plant we can bring in new capacity in about one-half the time that it could be done starting from scratch in another location. It is our opinion that when we can see additional firm energy, that additional firm energy will become available to us some date in the future, that we can contract for interim energy of some type or other at some cost or another, which would permit us to make expenditure for the capital plant and to increase the production of titanium. Four hundred and fifty million killowat-hours would be the equivalent of about 40 tons a day. That is a very small amount of a structural metal, actually, but it is many hundreds of times last year's production, yet it is only a fraction of the predicted requirements at an early date. I think it is quite plain that if additional firm energy can be brought into this area, it would be advantageous to the titanium program and to the community. One of the reasons that you can expand here so rapidly, not only the physical facilities that we have under contract here but the power system into the plant and distribution out of the plant are all developed at a capacity of about 225,000 kilowatts and it would be very difficult to duplicate them, and would require 2 or 3 years' time, I suppose.

Senator MALONE. This firm under which you are operating is one of several, I suppose, but probably the best developed one. Is that true?

Mr. SMITH. You mean our process?

Senator MALONE. Yes.

Mr. SMITH. The process that we are developing is the only, it or some of its variations are the only commercial process at the moment. All of us in this new industry have new processes in the pilot-plant stage which will probably cause our present process to become obsolete in some time or another However, that won't drastically effect the overall electrical energy requirement.

Senator MALONE. I think that any process would require about the same number of killowatt-hours per pound.

Mr. SMITH. In the same order of magnitude, yes, sir. Any that I know of.

Senator MALONE. Is there any information that you can make available, of course, this is public information, it is not an executive hearing, that you could make public as to the estimated requirements of this metal?

Mr. SMITH. No, I think any information that I have on that would be classified. Sufficient I think to say though, it is a number of times as much as any plans that we have.

Senator MALONE. In other words, the bottleneck to your future investment boils down to the assurance of adequate firm power for your operation at a price that you can use it?

Mr. SMITH. That is right.

Senator MALONE. Then you are definitely interested in any source of firm power, whether it happens to be further sources in the Central

Valley project or the two projects that have been mentioned in the lower Colorado River but above Boulder Dam.

Mr. SMITH. Price and reliability would be our only considerations.

Senator MALONE. Of course, you understand that these two dams contemplated above Lake Mead are about a 6- or 7-year job, passing the bill and constructing the projects. If we wait a year in starting them it will be just that much farther away. If it isn't classified information, what contracts do you have now; do you have any additional contracts from your original 10-ton-per-day unit?

Mr. SMITH. We are in negotiation for 150 percent expansion on it.

Senator MALONE. What about the cost of this product, does it have considerable to do with the letting of contracts now or is that relative.

Mr. SMITH. The unit cost of the product will decrease as the amount of production goes up.

Senator MALONE. As I understand it, it is about $16 a pound now.

Mr. SMITH. The average selling price of fabricated titanium is about $12.50.

Senator MALONE. Where should that price come to if adequate contracts were let and it could be reduced on what you might call a quantity basis?

Mr. SMITH. The pricing of our products does not come within my duties.

Senator MALONE. The price does have something to do, I suppose, with the quantity that could be used in the construction of planes, especially commercial planes. Do you have any idea about the demand, perhaps that would be classified, too, as far as military is concerned, about the commercial requirements and the commercial planes?

Mr. SMITH. Well, there is a substantial demand; however, the military by and large gets the entire output indirectly.

Senator MALONE. Yes, I understand that. Without divulging any classified information, I was trying to get at some figure that might be sufficient to estimate the requirements.

(Due to some difficulty in the transcription, one of the reels did not record. The following are the ones who appeared and whose statement was not recorded. The continuation of Mr. Smith, of Titanium Metals Corp.; all of Mr. Spalding, chief engineer of the North American Aircraft; all of Mr. Hitchcock, Staff engineer of structures of the Boeing Aircraft, and the first part of George W. Papen, chief production engineer of Lockheed Aircraft. Summaries of statements by Messrs. Spalding and Hitchcock are as follows:)

NORTH AMERICAN AVIATION, INC.,
Los Angeles, Calif., November 3, 1952.

Senator GEORGE W. MALONE,
Reno, Nev.

DEAR SENATOR MALONE: As requested in your letter of October 29, I offer below a summary of my remarks before the public works hearing at Henderson, Nev., on October 10, 1952.

I stated first that North American Aviation was currently using titanium in the construction of military aircraft and expected to continue its use in the future. The extent of future usage would be contingent, among other things, on availability and cost, and also on the development of improved alloys and experience with the use of titanium.

In answer to a question on the specific amounts of titanium being used, I replied to the effect that this might be classified information which I preferred not to discuss in an open hearing.

In answer to a question on the magnitude of future titanium usage, I stated that it was impossible for me to give any reliable figures since I had no knowledge of how many airplanes my company would build in any given future period. This would be dependent first on congressional appropriations, and second on decisions of the military services as to types of airplanes selected for future production.

Another question was whether the military services or the aircraft engineers and designers customarily specified what material should be used for each aircraft application. In reply, I stated that normally the designer is responsible for selection of materials. However, in special cases, such as those involving the use of strategic or critical materials, the recommendations or requirements of the military services would usually be followed.

I was asked if the previous testimony by Mr. Smith of Titanium Metals Corp. regarding power requirements for expansion of titanium production, together with my company's future usage of titanium, did not point to the need for additional power-generating facilities in the southern Nevada area. In replying to this question I first reiterated my earlier statement that our future titanium usage could not be quantitatively determined. Secondly, I pointed out that I had very limited knowledge of titanium production facilities in other areas of the country, particularly with respect to their power supplies. Because of these two indeterminate factors, it was impossible for me to state whether or not the additional power sources were really necessary.

The above statements are believed to represent the essential content of my remarks at the hearing.

Very truly yours,

L. P. SPALDING,
Chief Research Engineer.

BOEING AIRPLANE CO.,
Seattle 14, Wash., November 6, 1952.

Hon. GEORGE W. MALONE,
United States Senator, Reno, Nev.

DEAR SENATOR MALONE. Enclosed is a written statement of the general testimony as near as I can recollect it which I gave at the public works hearing in Henderson, Nev., on October 11. The written statement is relatively brief inasmuch as it does not include the material covered by my answers to your several questions during the testimony.

Incidentally, my testimony did not include any information relative to the need of titanium materials for aircraft engines. Titanium and its alloys is important for this application; however, such information should be obtained from the aircraft engine manufacturers or the Department of Defense.

It is hoped that the written information will be useful to you and to the Committee on Public Works.

I would also like to take this opportunity to congratulate you on your reelection.

Very truly yours,

L. M. HITCHCOCK,
Staff Engineer, Structures.

SUPPLEMENTAL STATEMENT PREPARED BY L. M. HITCHCOCK, BOEING AIRPLANE CO.

The Boeing Airplane Co. believes that it is of extreme importance that the development of titanium and titanium alloys and the establishment of adequate sources of these materials go forward on a high priority basis. We know that the usage of presently available titanium materials will improve the performance of our military airplanes and missiles. We further believe that in the next 3 to 4 years titanium alloys will have been developed and evaluated which will, to a greater extent, improve the performance of our airplanes and missiles. In speaking of performance, I am referring particularly to increases in range or payload or both. Titanium and titanium alloys can improve the performance of our military airplanes and missiles because we can obtain structures in titanium and titanium alloys which are as strong, but lighter than, the present structures of aluminum alloys and steel alloys. In other words, from what we know of present titanium materials and what we estimate that current and future development work will produce in the way of improved physical properties, we believe that titanium materials will have a much higher strength-weight ratio

than our presently available aircraft materials in aluminum alloy and steel alloy. We believe the use of titanium alloys in future airplanes will result in a 25 percent weight saving of many parts of the aircraft structure which now utilize aluminum and steel materials. Thus, the development and availability of titanium and titanium alloy materials is of vital importance to our military preparedness program.

The Boeing Airplane Co. has recently made a survey of the majority of the companies in the aircraft industry (in conjunction with our activities with the Aircraft Industries Association) relative to present and future titanium requirements of the industry. The results of this survey indicate that in the period of 1952 through 1955, approximately 5 percent of the airframe weight will utilize titanium and titanium alloy materials. The survey further indicates that in the period beyond 1955, approximately 25 percent of the airframe weight will be designed in titanium and titanium alloys. The term, "airframe weight," is considered as accepted terminology in the aircraft industry; however, for the record, the airframe weight is designated as the airplane weight empty less engines, propellors, wheels, tires, brakes, armament, and certain accessory equipment. We also have certain unclassified information available from the Aircraft Industries Association regarding the total annual military and civil aircraft production for the past several years in terms of airframe weight. Although the figures from 1950 to the present are estimates, the total annual airframe weight production in 1952 is estimated as 129 million pounds. It is believed that this number is considerably below actuality, and it is suggested that more accurate information could be obtained, if desired, from the Department of Defense under proper security restrictions. As a matter of interest, the total airframe weight produced on an annual basis during the peak of World War II in 1944 was 1 billion pounds. Under the conditions of 1944 or at present, the output of commercial airframe weight is a relatively small percentage of the total airframe production.

I would also like to call your attention to the fact that these production numbers are based only on military and civil airplane production and do not include any consideration of the missile program which would also use titanium and titanium alloy materials. Now on the basis of the industry survey in which we obtained percentages of airframe weight which would utilize titanium materials and the figures on pounds of airplane annual production, it is possible to make some estimates of the annual usage of finished titanium materials for airframe production in the immediate future and in the period beyond 1955. However, these numbers would make no allowance for scrap losses incurred due to manufacture. It is estimated that scrap loss in titanium materials will be as high as 50 percent in the immediate future, and as aircraft companies obtain the know-how on working with these new materials the scrap loss will decrease to perhaps 20 percent in the next 3 to 4 years. As to what extent the material loss due to scrap could be reclaimed without the use of the high amount of electrical power required in the initial reduction process of titanium ore to titanium sponge is not known by the Boeing Co., although it is probable that most of the material loss due to scrap could be reclaimed without use of a significant amount of electrical power.

(Mr. Papen continues as follows:)

Senator MALONE. I think as much of your conversation off the record that you could repeat would be helpful. My own personal opinion is that until we regain control of the air and have better airplanes than anyone else, the cost is not going to be much of a factor. That, then, is a decision that Congress or someone has to make so that we know what to do when coming down to the power development and other facilities to make this metal available.

Mr. PAPEN. Well, one of my main jobs is to keep the cost of the airplanes down; that is one of the chief things I am paid for.

Senator MALONE. I take it that one of your main jobs is to develop an airplane at the least possible cost to fulfill the specifications that are given you.

Mr. PAPEN. It is to develop the best airplane that can be developed today by the Lockheed Aircraft Corp. for the least amount of money.

Now, when you say the cost isn't important, I think it is. But I think we have got to look at cost as to what happens if we don't do it. It isn't a case of spending millions of dollars and saying, "Well, we are raising the cost." You are spending those millions of dollars to save millions more that are here and to protect them. But you don't spend that money, which I think is merely the cost of the program; it isn't additional cost and it isn't exorbitant.

Senator MALONE. You are talking in my language now. I did not mean to say the cost was not important, I said the cost was secondary if we have to spend the money to control the air. It is my personal opinion that if we control the air and keep ahead of everyone else, and control the ocean with our submarines, we have very little to fear, but right now we have plenty to fear. That, of course, as I previously said, I am interested in two things: First is keeping control of the air and the sea and next is to do everything in my power to keep these industries going where they are most feasible. Right now it seems that this is the area where this production is most feasible, therefore we want to know what to do and do it without delay. Your part of it is very technical. I have been in the engineering business for 30 years, but in a different kind of engineering. I might understand what you are talking about, but I couldn't help you in designing.

Mr. PAPEN. There has been a lot of talk here about what are classified and what aren't classified figures and what not. Here are some figures which are published and I think we could break them down to show what we are faced with today. This is a report sent to us, it is a National Production Authority, minutes of a special conference on titanium. The statement is made in here to the effect that titanium production is expected to total approximately, ending up at 8,000 tons at 1955. Now, that isn't clear whether that is 8,000 tons of metal titanium at our door or 8,000 tons of titanium sponge. The aircraft industry, incidentally, buys no sponge, we buy only metal titanium delivered at our door which is in a form which we can use. If it is 8,000 tons of sponge, according to what I hear, today it takes 2 tons of sponge to produce a ton of usable metal, so that is 4,000 tons. Now that figure is constantly reduced and maybe by 1955 that 8,000 tons, if this is sponge, will make maybe 6,000 tons of metal. But if we assume that it is sponge that is 8,000 tons of sponge, then we are going to get 8 million tons of metal and this is supposedly national. First you came up on commercial airplanes, since we didn't want to kick around military quantities, we just took a rough cut down here a minute ago in the production of the installation, the DC–6 and DC–7, and throwing in con * * * and ships and that, at those rate range, that if we use titanium on the percentages that the AIA report mentioned earlier, we run up to about 2 million pounds, 2,880,000 pounds of titanium metal for commercial aircraft, this is total. Now, these are just figures we have cooked up between us, based on what we know of the types of airplanes.

Senator MALONE. Is that immediately?

Mr. PAPEN. This is based on a year's production on a basis of 20 percent of airplane weight in titanium. Because after all commercial airplanes will follow along on basically the same military figure. So there is 5 million pounds of sponge per year that we would need for our commercial work and the output of the Henderson plant on a basis of 10 tons of sponge per day is going to give us only 3 million pounds

of sponge per year. So, our commercial program alone would use two-thirds of the output of this one plant. As I understand it, there are only two sponge producers in the country. Now, these are commercial figures. I think we can all realize and you can make your own guess as to what the mobilization figure would be on top of that or even what the present military figure would be. Now I have some figures here from our own ships, these are mixed up both commercial and military, so I think we can safely read off a few of them. We have called out all our designs today, and these are either actually in production, being put into airplanes, or are on drawings being released, and will be in effect in the next year, that they will be actual callouts. Two million three hundred thousand pounds a year is what we can use of titanium on our aircraft. That is just Lockheed.

Senator MALONE. That is beginning when?

Mr. PAPEN. That would be, I would say a year and a half minimum, probably 2 years from now that that quantity would be in use. That is based on what we know of the alloys and the pure materials today. As I say, the whole field is expanding so rapidly, that as fast as we know more about it we would get more usage. But upon what we know today, we could use that much if we could get it.

Senator MALONE. What would you say would be the percentage of the total use that you would need, that is to say, what percentage of the total use, you have some idea of what percent of commercial planes you would turn out. This is commercial planes you are talking about?

Mr. PAPEN. No, that figure includes all our production, that includes both military and commercial.

Senator MALONE. What percentage of the total do you estimate you would have under those conditions?

Mr. PAPEN. What percentage of the commercial?

Senator MALONE. Of all them.

Mr. PAPEN. I don't know; I couldn't even guess. I don't know that the national production figures are close enough to even give you an average or a percent.

Senator MALONE. Do you determine a fourth of the planes, a sixth at the present time?

Mr. PAPEN. I don't know. You got me on that one. That is not a case of classified, I just don't know what those figures are. I don't even know what Lockheed's production is. I imagine between Lockheed. Boeing, and Douglas, I imagine the 3 companies must put out pretty close to 40 or 45 percent of the airplane poundage, because they are putting out the larger ships mostly and those 3 companies are involved in both large and small. I don't know. I think it would be just wasting time to try to work anything out of that. To give you an idea of what some of this titanium can mean to us, weightwise, the question has been raised several times, but I don't suppose here, about the effect of temperature on skin sheets as we go up into the higher speeds. The boys worked out a deal here on one of our fighter planes that we now use 471 pounds of aluminum for skin sheeting on this plane. If the speed were increased to the range where we would get a skin temperature of 200° we would have to put in about 500, possibly 530, pounds of aluminum to carry the same load, because of the reduced strength at that temperature. At the same time, 426 pounds of titanium would carry the load at that particular temperature, of say 200°, titanium would put out a

completely lighter airplane. Which could be translated into range speed, rate of climb, or anything else you wanted to.

One other point that was raised here, I think I might throw some light on, you asked why the variations between the companies on a percentage usage. I think a fairly obvious answer to me would be this, if you were going into the missile field, a greater percent of your missiles could use titanium because a greater percent of it would be in temperature ranges and you don't have a lot of bulk. If you are going into a fighter or bomber field, even if you get up into the same, you would never get into the same speed range. But to get into the same speed range where titanium did become important, it would still only become important on the structural part of your airplane and the, I say a primary structural part, the rest of the structure, which is devoted to holding the passengers upright and keeping the seats from wobbling around in the airplane, and carrying radio racks, that would still be in the lighter alloys and they absorb a big percent. I can see very easily of say, Lockheed quoting 15 percent for something like a Constellation or maybe 20 percent for a fighter and going up all the way from 50 to 60 percent on a missile if we were thinking in those terms. So, that is one of the figures. I know that these figures vary. Another is the obvious reason that each company has, even today, a different degree of knowledge of the material. I have certain data which we have gleaned that North American has up on a basis of all sorts of things, we don't have their data yet, but the change is there. They don't have ours and we don't have theirs so they may come up with a different answer. Maybe we got something that would up their percentage if they knew it and they have something that would up ours. Each company is developing this material and learning more and more about it. So, in any stage of the game in making a survey, you are going to get a very wide spread for a number of years yet, as each of us talk. One of the biggest spread causes today is the difference between the pure titanium metal and the alloy. You want to be very careful when you read articles when people talk about the big usage of titanium that they are going to make, whether they are talking about commercially pure titanium or about alloys. When people talk about there being lots of titanium available, there again ask, "What are you talking about?" Sponge? I understand there is stockpile in sponge. Well, that is fine and dandy with me, we don't use sponge; let's go over to the mill and get some metal parts we can use out of it. We are not getting all the metal we want. The new titanium is apparently beginning to close the gap and our orders are coming to a pretty fair shape. The alloys, I say alloys are about at a standstill under the programs, it is moving and that is all you can say for it. It is the alloys that are going to bring these tremendous weight savings we have been talking about. We know what is in them.

Senator MALONE. What is the chief alloy of titanium if there is such a thing?

Mr. PAPEN. I don't know if there is a chief, there are several now that are being worked on. Each of the companies have their own and gradually out of that will come some standardization. You see, titanium is starting out a little different than aluminum. Aluminum started in a field, Aluminum Corporation of America controlled it, they were in it and no one else was in it and they developed their

alloys. As other people came into the field they produced the same alloys. Everybody was getting licenses so the thing was thrown open. Here in titanium we have got 3 or 4 companies all starting from scratch. Each fellow is going along in a certain field and over the years those fields will bring together the same series of alloys which we will have to standardize on to get production.

Senator MALONE. Well, Mr. Papen, I think you have made a very good presentation. If you have any data which you would like to submit as an exhibit we would like to have it, or anything that you would care to submit later as a supplemental statement we would be glad to get it.

Mr. PAPEN. Anything that I have here is yours, if you want to take it and read it now, or let me take it home and doctor it up and then give it to you.

Senator MALONE. You might doctor it up so that it can be made as an exhibit.

Mr. PAPEN. I can't find my own way through it, so I don't think you could.

Senator MALONE. Your testimony, which has been very comprehensive and very intelligent will help. We are still looking for some conclusion, and would it be your conclusion on what you know about titanium and titanium alloys and the statement of the manufacture of which you have heard here today, which probably you already knew, that the pressure should go on to further possible means to manufacture a greater amount of this metal, using the best modern methods and all the improvements but to really plan ahead and put more pressure on to get more of the metal will require more power in certain areas like this area, and the other materials that are necessary.

Mr. PAPEN. All I can say to that is, "Yes." The Government has already in this document I mentioned before, some Mr. Lynch, and his name undoubtedly has a title somewhere. He is in the Aluminum and Magnesium Division, NPA. He explains that NPA is concerned over the lack of sufficient titanium to meet current and future military demands. He stated that requirements are several times the estimated available supply. There is an official document which sums up, as they usually do, in a few words, what it takes me hours to tell you. The data they have are probably more accurate and vital than we can obtain and I am sure you can get it; maybe we could get it for you. All I say is, we know it; we are on the receiving end, or we would like to be on the receiving end. We aren't getting titanium in the quantities as we want it. If it takes, as I gather from earlier discussions here, more electric power, which is obvious, and if that is going to require more dams and other sources for the power, certainly we go along with you on it. We want titanium. We feel it fits a need, that it is something we need for airplanes, to get better performing airplanes, and to get better performing airplanes cheaper.

Senator MALONE. Apparently you further feel that any company that gets behind in the development, the alloys and the use of this metal, both in military and commercial planes would soon be out of step with the industry.

Mr. PAPEN. Absolutely.

Senator MALONE. In other words, this is a necessary metal. There is no argument about that.

Mr. PAPEN. I don't think there is a single aircraft company today that hasn't got at least one man concentrating on this material. At Lockheed, it would probably start another investigation if I told you how many men we have working on it.

Senator MALONE. I think you have answered the question. You have been very helpful, Mr. Papen. Will you be here tomorrow?

Mr. PAPEN. We had planned to leave early. How late have you got to run?

Senator MALONE. Until noon tomorrow and I doubt from your testimony, which has been very comprehensive, that we could ask you any further questions. We certainly appreciate your attendance and your testimony. Do you have any other member of your firm that would like to make a further statement?

Mr. PAPEN. I think not.

Senator MALONE. Thank you. I want to ask a question before we adjourn, then we will adjourn until 9:30 in the morning. I know there are several of you that have come a considerable distance. I want to give preference in the hearing to those men who wish to leave. We did have the matter of the power and the titanium metal that we wanted to complete before we start on the subject of irrigation projects and other matters for which the hearing was called. I had the State engineer, Mr. Shamberger; is Mr. Shamberger here?

Mr. SHAMBERGER. I am still here.

Senator MALONE. Is it necessary for you to leave tonight or could you be here in the morning?

Mr. SHAMBERGER. I am leaving early in the morning, before the hearing starts.

Senator MALONE. Then I think we had better call you right now. If you would take the stand in the interest of the irrigation surveys, Mr. Shamberger. Will you identify yourself for the record, before we start.

STATEMENT OF HUGH SHAMBERGER, STATE ENGINEER OF NEVADA

Mr. SHAMBERGER. My name is Hugh Shamberger, State engineer of Nevada. Senator, I don't have any prepared statements and my comments will be very brief, which I think will be appreciated by everyone, due to the lateness of the hour.

Senator MALONE. Yes. I was going to say before you start, do you understand and know about the bills we have introduced to utilize Colorado River water on southern Nevada lands?

Mr. SHAMBERGER. I am very familiar with those bills, yes, sir.

Senator MALONE. One of the things that we have counted on, and which you and I have discussed before, is the soil survey and the necessary surveys to determine the available land; that is, the land that will be available for irrigation under the conditions that exist here.

Mr. SHAMBERGER. I believe, Senator, that is a primary thing that must be done. The waters of the Colorado River, in the lower basin States, have not as yet been allocated and Nevada, of course, will have a claim on a certain amount of water. I believe that we should make every effort to determine the amount of water that we can use and to have the necessary data so that we can make a good presentation when

the time comes. That, as far as irrigation is concerned, is a soil classification study.

Now, we have been doing some work along that line, especially in cooperation with the Soil Conservation Service. George Hardman, State conservationist of the Soil Conservation Service, is here and I presume he will testify later. I believe the plans are for a detailed study within the Las Vegas area this winter, as well as in the Las Vegas Valley. We hope, in cooperation with the Soil Conservation Service, the Bureau of Reclamation, and the Bureau of Land Management, to at least make preliminary soil studies in other areas in Clark County on which the Colorado River water can be pumped and put to beneficial use. I have that in mind, Senator, and will do everything I can to get such information at the earliest possible moment. I must depend a great deal upon the cooperation of the Federal agencies. For the record, I would like to say that the cooperation that we receive has been outstanding.

Did you have any further particular questions, Senator?

Senator MALONE. I think not, Mr. Shamberger. You are ready to cooperate in every way with the Soil Conservation Service, the Bureau of Reclamation, and other agencies that may be available to make proper soil classification surveys and to determine the amount of land and its location that is suitable to irrigation under the conditions pertaining here.

Mr. SHAMBERGER. That is correct. I was going to mention briefly the Las Vegas Valley, where as you know several years ago a water district was formed, the Las Vegas Valley Water District, for the primary purpose of making Lake Mead water available for the valley. That was a very fortunate thing, because the safe yield of the average annual replacement of ground water in the basin and the valley, of course, with the exception of the Henderson area here, is at present dependent upon ground water. The safe yield has been reached and was reached several years ago. At the present time we are certain that we are now pumping from storage water and that this pumpage will increase naturally as the valley increases in population. The future needs of the valley will have to be taken care of by the waters of the Colorado River. The district has completed, or practically completed, negotiations with the Las Vegas Land & Water Co. for their water facilities. A bond election will be held late this winter to raise $7,500,000 which will be used to purchase these facilities of the water company as well as to construct a pipeline from the present Lake Mead-Henderson pipeline and take the water into the Las Vegas area. Every effort should be made by the people in the valley to insure the success of this bond election. In my opinion the future of the area depends upon being able to supplement the present ground supply with Lake Mead water.

The flood control has been discussed by Colonel Shuler. I am very glad that there may be a possibility of getting an appropriation on the Pine and Matthews Canyons Dams. I believe that is extremely important from a national defense picture. Also, it is important, I believe, to get the study made on the Las Vegas Valley Wash area, the Las Vegas Wash, and I am wondering if consideration shouldn't be given to the fact that this area is, and has been an area that houses a great many defense workers, and people who are

employed in national defense activities. I think that Mr. Nielson or Mr. Larsen of the Bureau of Reclamation will detail the Moapa Valley project before us and the Muddy River and also the Mohave project. The Mohave project is in the southern tip of the State so it probably is not necessary for me to go into that. I am sure you have been through that. I have the desire to help as much as possible in making examination of the exact amount of water that is required, an estimate on the amount of water based on reliable data, so that we can make a good presentation when the times comes.

Senator MALONE. Hugh, I appreciate your appearance here and your willingness to cooperate. I think some reconnaissance surveys have been made, it has always appeared to me that the surveys perhaps were not made with a view of what could really be done in this area, but were made at a time when there were very few workers in the area. Naturally, during World War II when we had the magnesium development it was a temporary development and they realized that and even the houses were constructed on a temporary basis. Now, however, if our plans work out, for necessary additional power here, I can see that instead of approximately 2,500 to 3,000 employees in the area, there might be 2 or 3 or 4 times that number within a reasonable number of years. If that is true and a better estimate can be made, by the time your soil surveys are completed and we know what can be done, then a large number of these industrial employees will locate on small tracts of land if they are available, in my opinion. They have done it elsewhere. This is not a new idea. Where the workingman having a job can have a quarter of an acre, an acre or 2 acres or 5 acres or 10 acres of land, where he can raise some turnips, potatoes, and have an apple tree or two and a cellar, and when he is laid off, which often happens, he doesn't take it too seriously for a few months. Whereas, if he only has his salary, a couple of months out of work would be serious. So in that case, a man can pay more for water and for fertilization of land than he can if there were contemplated wheat producing areas or large areas of farm land. This entire area appears to be heading for a small area of forms, so that with all that in mind, I have introduced these six bills that reach from the Mormon Mesa to the southeastern corner of the State which I have just described. They may or may not take in all of the lands that are available, but it was the best job we could do with the surveys at hand. As you suggest, I am sure that Mr. Hardman and the Bureau of Reclamation and other agencies will cooperate. They have already expressed their desire to cooperate, but I do believe that the State engineer of the State is the logical if not the leader and chief participant in the surveys, because it is of the utmost importance to the State.

Mr. SHAMBERGER. I have already had some talks with the Bureau of Reclamation and the Bureau of Land Management and of course, a number with Mr. Hardman. We expect to continue and work out a program and get as much done this year as we can.

Senator MALONE. What time would you reasonably expect to get started if all the other agencies were to cooperate, as you think they will?

Mr. SHAMBERGER. I think perhaps Mr. Hardman can best reply on that. I do know that he is planning to start within a month or two in the Las Vegas Valley.

Senator MALONE. To take advantage of the winter months.

Mr. SHAMBERGER. That is right; and also they have worked on aerial photographs and some delay has been caused by delay in getting the aerials.

Senator MALONE. Has there been any study or estimate of the time it might take to do an adequate job on the aerials?

Mr. SHAMBERGER. Again Mr. Hardman can advise on that. On the type of study I think needed which is on the Mormon Mesa, it wouldn't take too long. Especially when you have these aerials to work with.

Senator MALONE. In other words, there is a sameness of the area and not much difference in classification and it can be covered pretty fast. I am very much interested in your statement, which I knew already to a certain extent. I think you have much more information, as was remarked today at the club. I started as State engineer in about 1927 and as you probably know we laid the groundwork for underground water laws. We tightened them gradually, because we did not have the information necessary upon which to base a decision. Then Tom Smith came along, over his 16-year period, and further advanced the surveys; you were his assistant for a time as he was mine for a time, and now you are the State engineer. You may have accumulated data that was not available to either of us. Your statement that the ground water is already overappropriated in this area is very interesting to me. Could you enlarge on that just a little as to what might happen in this area with this continued influx of people from 4,000 in the area when I came down here in 1927 to start the work in the Boulder Dam project, to the 45,000 that is in the area now, and if it continues to grow, what could happen to this area if there is no other source of water?

Mr. SHAMBERGER. Well, in 1935, the State engineer in cooperation with the United States Geological Survey, Ground Water Division, set up a very comprehensive study of the ground-water conditions in the Las Vegas Valley. Mr. Robinson, district engineer at that time, in charge of the Ground Water Division for the USGS is here and will no doubt testify as to some of those studies in this part of the State. The main purpose of the study was to determine the safe yield in the valley, or the average annual replenishment to the ground water in the valley. That was done and it was determined that the average replenishment is in the neighborhood of some 31,000 to 35,000 acre-feet yearly. I believe that is approximately the range.

Senator MALONE. When was that study completed?

Mr. SHAMBERGER. It was completed in 1948 I believe, and a report issued in 1949. The report was issued as a Water Resource Bulletin No. 5.

Senator MALONE. A State engineer bulletin?

Mr. SHAMBERGER. A State engineer bulletin.

Senator MALONE. I think it would be well to submit a copy of one of those bulletins for the benefit of the record.

Mr. SHAMBERGER. Mr. Robinson has a copy and will submit it as an exhibit. In about 1946 the use of water from the valley reached the approximately safe yield and in 1950 it exceeded the safe yield, and in 1951, I think last year, we estimated was between six to eight thousand acre-feet above the safe yield; 1952 will exceed that considerably.

Senator MALONE. What would be the rate of receeding of the underground water table?

Mr. SHAMBERGER. It has been receeding from 2 to 3 feet in the last 2 years. In some areas it is 3 feet or better. Generally over the valley I believe it is about 2 feet.

Senator MALONE. Now that, could that recession be expected to increase in the years ahead as the population increases and underground water is the only source?

Mr. SHAMBERGER. It would probably increase a little as the years increased. It would receed until the water table got to such a point that due to economics there would be less water pumped and a natural balance would be arrived at.

Senator MALONE. What is the drawdown now, that is, the surface water and the drawdown for the average well?

Mr. SHAMBERGER. That varies. In the area where the well furnishes water for the Las Vegas Water Co., the specific capacity is some 30 to almost 100 gallons per minute, which is quite high. In other words, that is an excellent well field. In other portions of the valley the specific is much less.

Senator MALONE. Then any pumping affects it immediately.

Mr. SHAMBERGER. Oh, yes; that is as a cone of depression is built up around each well and where you have heavy pumping the cone is quite low.

Senator MALONE. What then is the average depth of the water service as it stands; perhaps you would have to answer that in various sections of the valley.

Mr. SHAMBERGER. Yes, I would. In some areas we have flowing wells and in other areas wells that were once flowing but are not flowing now and the water stands 30, 40, or 50 feet below the surface.

Senator MALONE. In other words, the increased depletion pumping each year is more than the inflow into the valley and has caused the flowing wells to recede.

Mr. SHAMBERGER. That is correct.

Senator MALONE. Then you can look forward to the time, with the growing population, when it would be uneconomic to pump water for anything but domestic drinking-water purposes, and domestic purposes? And in time you might run out of that kind of water; is that it?

Mr. SHAMBERGER. That is true. We have no knowledge of the capacity of the underground reservoir. We don't know how long it would take to exhaust it, but we do have rather comprehensive groundwater laws that give the State engineer some very definite provisions that he can follow when a condition like this takes place.

Senator MALONE. Does the present law provide now that you can shut down wells in order of priority and so lengthen the time of depletion of underground water? The law did not when I was State engineer.

Mr. SHAMBERGER. That is right, the law does now. Now, if this area was purely an irrigation area we would probably have shut down before but we have felt that we couldn't shut down while high beneficial use is being made. We have the idea in mind that there would be new water coming in and we informed the people, when Mr. Smith was State engineer, we informed the people in the valley that we would continue the granting of permits if they would go ahead and create a legal water district and proceed with bringing the water from

Lake Mead in to supplement the ground water. Naturally in order to build up values to allow them to do that you have to let them continue to use water. In other words, had we stopped the drilling of wells in 1946, then the valley would probably not have become financially capable of going ahead and bringing in new water from Lake Mead.

Senator MALONE. It was a question of economics.

Mr. SHAMBERGER. The same thing has happened in many other places. In Los Angeles where if they had depended upon the ground water and not used it all up, it would probably still be a small town.

Senator MALONE. Then your conclusion has been for some time, since 1945 or 1946, that there must be a supplemental water supply even for domestic purposes and for industrial and mining purposes, to say nothing of irrigation if you want further irrigation.

Mr. SHAMBERGER. That is correct.

Senator MALONE. Then the bills that I have introduced, of roughly 231,000 acres, of course, knowing full well that a large percentage of the land included in these projects would not be suitable, and might be cut down below 200,000 or even less, but if these projects prove to be feasible, and the water was pumped on the land, naturally the domestic water supply and the industrial water supply will be automatically solved.

Mr. SHAMBERGER. That is correct.

Senator MALONE. Unless you have some further information, Hugh, that has been a very comprehensive statement you have made. We will arrange to have whatever bulletins that have been turned out on the valley to be submitted and made a part of the record. I certainly appreciate your coming down and your willingness to go to work on this project.

Mr. SHAMBERGER. I think it is the responsibility of my office to do as much as we can to determine what the needs are because water is a key to everything in this southern area.

Senator MALONE. As we have often said over the years, the limit of a State's water supply is a limit of that State's development, and this area is particularly susceptible to that. It has been my conclusion from the beginning, from 1927 when I first took a look at Nevada, that we were rapidly reaching the condition you have now reached, and the only solution for the people, if we are to continue to grow, would be a supplemental supply from the Colorado River, and that, of course, was the foundation of the engineers' report. There were three, Ed Hyatt, State engineer of California, myself as State engineer of Nevada, and Mike Hinderlider, State engineer of Colorado—Hinderlider is still State engineer—made the report on the lower basin States at the request of the Colorado River Basin States in 1935 as to what the lower Basin States could use, and it said at that time that Nevada could use 900,000 acre-feet of water. That was the basis of the introduction of a bill covering the land that you presumably will cover with your survey. If that is the end of your testimony, we will adjourn until 9:30 in the morning. Unless there are witnesses who must leave tonight—in which case we will hear them—otherwise we will come back at 9:30 in the morning.

(Whereupon, at 5:20 p. m., the subcommittee recessed to reconvene at 9:30 a. m. the following day.)

FLOOD CONTROL, POWER, AND WATER-RESOURCE DEVELOPMENT, COLORADO AND MUDDY RIVERS, LAS VEGAS WASH, NEV.

SATURDAY, OCTOBER 11, 1952

UNITED STATES SENATE,
SUBCOMMITTEE ON FLOOD CONTROL, RIVERS, AND HARBORS, OF THE COMMITTEE ON PUBLIC WORKS,
Henderson, Nev.

The subcommittee met pursuant to adjournment at 10 a. m. in the Victory Theater, Henderson, Nev., Senator George W. Malone presiding.

Senator MALONE. I am sorry I am late this morning, but my telephone was continually ringing. We will divert temporarily to the power section of the hearing, and we will try to keep together all the reference to power, and all the reference to water storage and flood-control irrigation in the preparation of the transcript. Mr. Fred D. Gibson, general manager of the Western Electrochemical Co. is here this morning and has submitted a letter to me for the record, which I will read.

(The letter referred to is as follows:)

WESTERN ELECTROCHEMICAL CO.,
Henderson, Nev.

HON. GEORGE W. MALONE,
United States Senator for Nevada,
Committee on Public Works

DEAR SIR: I wish to place the following statement in the record of your Committee on Public Works.

Western Electrochemical Co. has a contract with the Colorado River Commission of the State of Nevada for the delivery of 232 million kilowatt-hours of energy annually. We have installed d. c. conversion equipment in the amount of 35,000 kilowatts. The conversion units operate normally at about 90 percent load factor, resulting in an annual requirement in the order of 280 million kilowatt-hours, plus the power needed for the various auxiliary operations. Our present contract is, therefore, in the order of 50 million kilowatt-hours short of that necessary to operate our presently installed equipment. All of our products, with exception, are essential in the defense effort or for critical civilian needs. They consist of sodium chlorate, the base material used in the manufacture of perchlorates, and also used in the match industry, for bleaching paper pulp, as a defolient and weed killer; potassium and ammonium perchlorate, the oxidizing agent used in solid fuel Jato program by the military; and, electrolytic manganese dioxide, a product used by the Signal Corps in the manufacture of dry batteries for specialized service.

We are at present involved in the planning of additional capacity for defense needs. The proposed new capacity will require in the order of 250 million kilowatt-hours of energy annually. We are informed that the installation of these additional facilities is very urgent. The decision relative to the location of the proposed plant will be determined primarily on available power. The installation of these facilities at Henderson, Nev., intergraded with the existing operation

will result in the saving of several million dollars, as well as an important saving in construction time.

Very truly yours,

FRED D. GIBSON,
General Manager.

Senator MALONE. Mr. Fred D. Gibson, general manager of Western Electrochemical Co., from the letter the committee gathers the information that you are 50 million kilowatt-hours annually short of your real needs at the present time.

Mr. GIBSON. That is correct.

Senator MALONE. From this letter, would we gather that even if you do not get the additional plants, national defense plants, mentioned in the second paragraph of your letter, that progressively you might be even more short of power in your original work?

Mr. GIBSON. I would say that between 50 and 60 million kilowatt-hours will be our shortage as long as we make no further expansion, we couldn't use any more power than that, that is our installed capacity at the moment.

Senator MALONE. Then the 68 million kilowatt-hours short is possible and probably during the years ahead in your present plant.

Mr. GIBSON. That is right. I have contracts for, as soon as, at the moment we are involved in construction, these plants are not complete, but we have contracts for the delivery of products on the books now that will require the operation of the plant at capacity.

Senator MALONE. Your second paragraph in the letter is very revealing. Is this new capacity about which you speak in the second paragraph that will require up to 250 million kilowatt-hours additional annually, is that plant capacity in the line of work in which you are now engaged?

Mr. GIBSON. That would be all military.

Senator MALONE. It might be different products than you are now producing.

Mr. GIBSON. No, it would be the same products.

Senator MALONE. In other words you have to have assurance that this power is available when your plant is completed or you could not make the investment. Would it endanger, providing you had to move to some other area, to secure this additional 250 million kilowatt-hours of energy annually and the 50 million which you are now short for your present plants, if you had to move elsewhere and construct your plants, would that possibly endanger your present investment? Would there be a danger or a likelihood that you might move the entire plant if you had power in one location?

Mr. GIBSON. It would undoubtedly be true that the operation from our standpoint would be a more substantial one if it were in the same plant; it would tend to give you better operating conditions.

Senator MALONE. In other words, when you separate your managerial organization it would mean a duplication of expense, therefore you would like very much to have the assurance that you would have this additional power, which would mean 300 million kilowatt-hours annually, and you would have all of your plant here, you would very much prefer that.

Mr. GIBSON. We certainly would.

Senator MALONE. There seems to be only two sources of additional power that are not subject to recall and that would be the Shasta Dam

power, the possible future withdrawal of Folsom power when it is ready in 1954—that would be maybe fifty or sixty thousand kilowatts, and from future dams on the American, Feather and Trinity Rivers in the Central Valley project of California and Bridge Canyon and Glen Canyon and other developments on the Colorado River.

Mr. GIBSON. That is our only hope in this location.

Senator MALONE. It is the only hope in this location for a firm commitment in the future. In other words, as Mr. Shaver outlined, you have been able to secure for the future a temporary supply of power from California and other sources but it is subject to recall whenever they need it.

Mr. GIBSON. That is true, and of course, that isn't the sort of power on which we can accept firm commitments of delivery of our products for a very long period of time.

Senator MALONE. You couldn't make your additional investment on that basis, you would not do that. I think, Mr. Gibson, you have made a very fine statement here and it is very clear and the committee appreciates receiving this information. The whole purpose of the hearing, as you have probably heard, although you were not here yesterday, is to ascertain the true national defense condition, and of course, the civilian condition also. Presently the Committee is most interested in national defense and in regaining control of the air and the sea and making available the essential metals and products. We discussed titanium at some length yesterday, which is a very important metal in the production of national-defense equipment; nothing was said about tanks yesterday, but tanks can be made 25 percent lighter and just as strong, in addition to air equipment and submarine equipment. Your Western Electrochemical Co. does supply a considerable amount of supplies that are used in this national-defense program?

Mr. GIBSON. That is true, and while we are in the habit of thinking, our perchlorates going into the Jato program, which is jet takeoff units, a good proportion of it at this time is starting to move in the guided-missile work. I think your committee would have access to such information as to verify those statements, and if we can be of any further assistance here, we want to be.

Senator MALONE. It is entirely likely that someone representing your company will be called to Washington in the executive session when the committee gets to work. I hope the heads of these other companies will be down here. I will recess and you tell them they can come in Monday if they want to. Thank you, Mr. Gibson for your statement, and your letter; I know it will be very helpful to the committee.

Mr. GIBSON. Thank you, Senator.

Senator MALONE. Is there present this morning a representative of any other industry in the area? Will you identify yourself for the record, please?

Mr. ARTHUR NEWELL. My name is Arthur Newell, I am works manager for the Stauffer Chemical Co. of Nevada, subsidiary of Stauffer Chemical Co., the parent concern.

Senator MALONE. Mr. Newell, we are very glad to have you here this morning. You are entirely cognizant of the reason for the hearing, on the ground at this time, and that is to lay before the Senate Public Works Committee in January, as complete a story as can be had relative to the actual conditions here, present conditions, present pro-

duction, and potential production, both in national defense and civil production, and the bottlenecks, if any, what they are, how pressing they are. In other words the future of the national defense industry and the civil production in this area, on what it depends, and what the committee can do or must do to facilitate the production. You may make any statement you care to in your own way.

Mr. NEWELL. Senator, I would like to state that the Stauffer Chemical Co. of Nevada has been in operation at the Basic Magnesium project since May of 1945.

Senator MALONE. You were one of the first here.

Mr. NEWELL. We were one of the first. Our principal products are chlorine and caustic soda, DDT insecticide, benzine hexychloride, muriatic acid. Our main product of chlorine is used here on the project in making the metal titanium. As titanium expands, chlorine will necessarily have to expand with it. Chlorine is used also in making the insecticides, and is also shipped to the coast and used in municipalities in sewage treatment and in water treatment. Caustic soda is used here on the plant to a minor extent but it is much used on the Pacific coast by companies, like the oil companies. It is used in producing aviation gasoline and in making soaps and detergents, and other sodium chemicals of various kinds. Muriatic acid is produced here at the plant as a byproduct, and is used by the Western Electrochemical Co. and also by Titanium Corp. It is used in the northern part of the State in recovering tungsten. It is also used in the mountains of California for the recovery of the so-called rare earths. In order to give you an idea of the growth of our company, particularly the increase in the consumption of power, I will say that in 1946 our annual consumption was 105 million kilowatt-hours. In 1951 that consumption, that was last year, had increased to 211 million kilowatt hours. The capacity of our plant is set up in such a way that we refer to it in terms of chlorine circuits. We have a firm contract with the Colorado River Commission for 139 million kilowatt-hours, which is sufficient to operate three chlorine circuits. During 1951 we operated 4 and 5 circuits, but not on firm power. The fourth and fifth circuits require that we have an additional amount of 84 million kilowatt-hours, making a total annual consumption of 223 million kilowatt-hours. In the future, with the possible expansion of titanium and other chlorine users, it is possible that we will have to put on a sixth circuit which is the maximum foreseeable capacity of our plant and then we will require a total of 267 million kilowatt-hours. That, Senator, covers about all that I have to state in this hearing, unless you have some questions.

Senator MALONE. I think your statement was very clear. In other words your rate of production has been somewhere around 10 percent a year or more, maybe 15 percent.

Mr. NEWELL. It has actually doubled in the period from 1946 to 1952.

Senator MALONE. Now, your need at this time is about 10 or 15 million kilowatt-hours more than you actually have and the foreseeable future, beginning in 1953 you would need the 267 million kilowatt-hours, which would mean you are short about 57 million kilowatt-hours annually.

Mr. NEWELL. We will actually be short, Senator, 84 million kilowatt-hours, which is the amount required to run the fourth and fifth

circuits. The sixth circuit is problematical at this time, but it will undoubtedly come on in the years to come.

Senator MALONE. Now, you have explored the entire area, do you know of any other source of power, firm power, that would belong in the area, could not be taken away, except Shasta power when it is finally delivered here, and other firm power from the Central Valley project as has already been outlined, and Bridge Canyon, Glen Canyon, or any other Colorado River developments.

Mr. NEWELL. The only firm power that we know of at the present time is from Hoover, Davis, and the possibility of Shasta power if it can be wheeled in.

Senator MALONE. In other words, the power that we get from California and Arizona are what might be called interim power or subject to withdrawal by them whenever they need it.

Mr. NEWELL. That is my understanding, sir.

Senator MALONE. Now, it was mentioned that we might get into the use of steam power through the use of coal from Utah, natural gas from the pipeline that is being extended from Texas to northern California, and which, no doubt would be a good source of auxiliary power, and would probably be useful in the area as standby anyway. Have you ever considered that source of power, those sources?

Mr. NEWELL. That matter of steam power as standby has been discussed on several occasions but no action has been taken on it that I know of at the present time.

Senator MALONE. You would consider it helpful if it could be done?

Mr. NEWELL. I believe that is right, sir.

Senator MALONE. I would consider it very helpful as an auxiliary and perhaps as prime power. I think that is all, Mr. Newell. Do you have any other member of your firm that might be available within the next week that would have any additional testimony to offer?

Mr. NEWELL. We have here today, Senator, Mr. Fred Weiss, who is attorney for our company out of San Francisco and we also have as a consultant Mr. Roy Martindale. I don't know whether they have any testimony that they might want to offer at this present time. They may do so if they wish.

Senator MALONE. Thank you. While I have not mentioned it to Mr. Gibson or the others, we do not intend to adjourn the meeting. We will probably try to complete the formal hearing on Monday or Tuesday and then simply recess the hearing so that any supplemental information you would care to submit in the form of exhibits can be made a part of the record if you wish to do so.

Mr. NEWELL. Thank you very much. I will be available on Monday and if there are any questions that we can answer we will be glad to come.

Senator MALONE. I would appreciate that, because we would like to sum it up on Monday. Now, Mr. Fred Weiss or Mr. Roy Martindale, would you like to come forward for any additional testimony?

Mr. FREDERICK WEISS. Senator, I am Fred Weiss, I have nothing to add to the testimony given by Mr. Newell.

Senator MALONE. Is Mr. Harvey McPhail here? If that completes the testimony of the actual power users who are here at this time we will again revert——

Mr. McGONIGLE. Senator Malone, I represent Manganese, Inc., one of the power users.

Senator MALONE. Will you come forward? I am sorry. I will hear you right now. Will you identify yourself for the record and proceed with your statement?

STATEMENT OF F. A. McGONIGLE, GENERAL MANAGER, MANGANESE, INC.

Mr. McGONIGLE. I am F. A. McGonigle, general manager of Manganese Inc. Senator, we have just completed the building of a new plant for the treatment of manganese ore and the production of manganese dioxide nodules. At the moment we are running the plant on a test basis breaking in the equipment. We are one of the smallest power users in the area, inasmuch as our annual power requirements are only about 18 million kilowatt-hours. At the moment, however, we have a firm contract for 6 million kilowatt-hours. That contract, of course, would be with the Nevada Colorado River Commission. What we are going to do in order to obtain a firm contract for the balance of that power remains to be seen. Although I understand, steps are being taken to arrange for that power. For the time being, nevertheless, we have to depend on the sources of dump power from the two dams on the Colorado River to meet our requirements. Even though we are one of the smallest power users in this area, I do not want to underrate the importance of our production. All the manganese that we produce is sold under contract, that is, to contracts to the General Services Administration. When we are in full production, which will be shortly, we will be making somewhere around 500 long tons of manganese nodules a day, and the content of those nodules will be in excess of 46 percent manganese. We also have as a by-product, lead and will probably be making from 20 to 30 tons a day of lead slugs, that will assay about 50 percent lead. When we are in full production with the manganese, I want to state for the record here that we will increase the domestic manganese production of the United States by more than 80 percent. I want to emphasize the importance of our operation on that basis.

Senator MALONE. Right at that point, Mr. McGonigle, much, I call it propaganda, has been dessiminated over the United States, to the people of the United States over a period of years, that we really have no manganese, that we must depend upon foreign countries entirely, and of course, the propaganda was hotter than a firecracker. That was the excuse for trading with Russia, that we must get manganese from Russia. Now, I have been in the engineering business for 30 years. I always thought that if we were paid for producing manganese, that while we might not produce our entire needs, which would not be probable, at least we would have our production operating at all times, supplying a substantial amount of our needs, and we would be able to step it up and practically become self-sufficient within a short period if we really got in a jam. I would like to have your general idea on that if I don't divert you from your main testimony. I know, for instance, that there are tremendous amounts of manganese in the Nevada Pioche district. I believe you are more familiar with it than I am. Would you give us a short statement on that subject?

I mean we pay for the manganese, and we pay a premium for foreign ores, like lead and zinc, and copper. Copper, we pay 36½ cents for foreign copper and 24½ cents for domestic copper, which is the silliest thing on earth, in my opinion. Of course, I am only one member of my own committee. But I feel very strongly on these things. We are the ones who should get the premium because we pay the 10, 15 dollars a day per shift where they pay from 50 cents to $2.50 a day per shift, and they use our machinery that we gave them in the beginning. Of course, I shouldn't start out on this, I just get mad when I think about the way our own producers are trading, but would you give me your idea on this thing?

Mr. McGONIGLE. Senator, the manganese situation in the United States is critical. According to the latest figures published, the United States only produces about 8 to 10 percent of its requirements.

Senator MALONE. And it did produce only 3, 4, or 5 percent for the very reason I have outlined for many years.

Mr. McGONIGLE. Exactly that and up to 1948 Russia was the greatest exporter of manganese and all of a sudden that source was cut off. Now we have had to depend upon increasing the imports from the west coast of Africa, Brazil, India, and various other sources in the world. But, we want to realize immediately that those are all long ocean hauls, and in case there should be a serious disturbance or war in the world, we may lose those sources in pretty much of a hurry.

Senator MALONE. Diverting right at that point, I sat with the War Production Board, I was consultant to the Secretary of War in World War II, and to the Subcommittee on Strategic and Critical Minerals and Materials of the Military Affairs Committee of the Senate. The War Production Board, those handling manganese and chromite were shivering in their shoes because 80 percent of the shipping from South Africa was being sunk by German submarines at one time during World War II, just exactly what you are saying.

Mr. McGONIGLE. That situation could repeat itself, too. There are, as you mentioned, Senator, various deposits of manganese in the country. The one that we are operating known as the Three Kids Mine is the largest, best grade deposit in the United States. It isn't so large when you think in terms of the iron mines, copper mines, and many other of the metallics. For instance, we have an assured ore reserve of over 3 million tons, averaging only 18 percent manganese whereas if you will study the records, for instance, in India, the tailings or the discards from the hand sorted manganese there are 30 percent or better. In other words, they are far richer than what we are trying to treat here. We have had Indian engineers come over here and they were amazed at what we were trying to do and what we were accomplishing here, because our grade of ore is barely half of what they throw away. Nevertheless, we are pioneering the treatment of the manganese dioxide ores in this country. This is a combination of nearly 2 years of experimental work and close cooperation of the United States Bureau of Mines, and the cooperation at Boulder and a good many of their technicians throughout the country. We have every reason to believe that this venture is going to be a commercial success. Now, there are a good many other manganese deposits in the United States. For instance the Anaconda Copper Co. has been treating the carbonate ores for a good many years, but their process is different than ours. There are the manganese deposits at

Pioche, which you mentioned, Senator, and the Pioche Manganese Co. is exploiting them. There are deposits in South Dakota, Arkansas, Maine, Virginia, and other places, but each one of those deposits is a problem. For instance, now based on our process we know that we can treat the oxide ores, but when you come into the realm of silicate ores there is no known commercial process that has been developed yet. No doubt it will come with time.

The only plant that operated in the world similar to ours was Cuban Manganese Corp., which was a subsidiary of the Texas Gulf Sulphur Co. They operated in Cuba for a period of about 17 years, but they shut down about 5 years ago. Their ores were a little different, and of course we were a little fortunate in being able to call upon them for some help based on their experiences. But on account of the difference of the ore we have had to develop on our own an entirely different process. I just wish to emphasize at this time again that the manganese situation in the country is critical, and the Government has been and is taking the right steps for setting up the purchasing programs, although in our opinion it still is deficient. The program for buying the ores in Deming is limited to too small a tonnage. The one in Arizona isn't opened yet, and the one at Butte and Philipsburg is going to operate on too small a tonnage basis also.

Senator MALONE. Well, Mr. McGonigle, isn't the critical situation due a good deal to the Government treatment of domestic producers? In other words, they discourage, at least not encourage, domestic production because there is no assurance of a unit price that would be profitable being maintained beyond an emergency. That we have always allowed free competition of foreign ores, like you have just mentioned; India, South America, South Africa, and Cuba, so that the producers now for the first time are receiving real encouragement during this emergency, contracts under which they will be assured their money will be returned.

Mr. MCGONIGLE. That is the situation, and the Government is starting to give assistance to the domestic program. We can't hope to compete with the foreign ores which by hand sorting will average more than 50 percent manganese on the payment of the very low wages that you mentioned, Senator.

Senator MALONE. In other words, it comes down finally, even if the manganese were of the same grade, to the wage standard and the difference in standards of living here and abroad, and the differential simply can't be made up any other way except to favor the production of domestic ores, which might be through a tariff or an import fee or some long-term contract that you are now operating under.

Mr. MCGONIGLE. That is the correct situation. Of course, I believe we can eliminate the possibility of this country having a high grade ore deposit because so far none are known, and the country certainly has been searched.

Senator MALONE. At Anaconda, they have a small amount of high-grade ore there. On the long run, the premiums are paid on foreign production and have been for many years.

Mr. MCGONIGLE. That is right.

Senator MALONE. You may proceed with your statement. I dislike to interrupt you, but I wanted to bring that out.

Mr. MCGONIGLE. Senator, I believe I have given the basic facts on our situation down there, and just to repeat it, our need for firm power

is critical. We hate to proceed with this venture without knowing where the source of our power will be.

Senator MALONE. Your process is not an electric process, is it?

Mr. MCGONIGLE. No; ours is hydrometallurgical and pyrometallurgical.

Senator MALONE. So your power needs are not so great per unit of production, but they are just as necessary, the amount of power you need for the operation of the plant is just as necessary, though smaller than electrochemical plants. As I understand it, you are 12 million kilowatt-hours short under your contract.

Mr. MCGONIGLE. That is the correct figure.

Senator MALONE. Do you have in mind any expansion that might increase the shortage?

Mr. MCGONIGLE. At the time being we do not contemplate any expansion because the plant has been designed and constructed to treat the 1,200 long tons of ore a day. If, with further development work, we find more ore, then we probably will expand the plant.

Senator MALONE. Now these Pioche deposits that are well known at this time, would this take a greater need for power when they are ready in that area for production?

Mr. MCGONIGLE. I am not familiar with that operation, Senator.

Senator MALONE. I am somewhat familiar with it, but we will not go into it unless you have the details. Thank you Mr. McGonigle, and if you think of anything that you would like to submit in a supplemental written statement, the hearing will merely be recessed so that the material may be received for part of the record during the immediate future.

Mr. MCGONIGLE. Thank you Senator, I am glad to have assisted you in any way.

Senator MALONE. Now does that complete the power users in the district for the time being? If it does, I want to call, we had Mr. Robinson and Mr. Odell here this morning, they may decide which one should make the first statement on the water situation, water supply of the valley.

Mr. BELL. Before we get into the water situation, I have a short statement from the Federal Power Commission on the power matters that might well be taken up now.

Senator MALONE. I think that is a good idea. Will you come forward and identify yourself for the record. Mr. Robinson, we will call you in just a minute. I want to emphasize again that on account of the presence of witnesses the power and water hearing has been somewhat intermingled and in the final transcript we will try to keep them separated.

STATEMENT OF GEORGE R. BELL, ELECTRICAL ENGINEER, SAN FRANCISCO REGIONAL OFFICE, FEDERAL POWER COMMISSION

Mr. BELL. My name is George R. Bell, electrical engineer, from the San Francisco office of the Federal Power Commission. I have only a short statement which is along the same line as you received yesterday. The Federal Power Commission through its San Francisco regional office published in May 1950 a power-market report of the lower basin of the Colorado River. The power market area included in this area included most of southern California, southern

Nevada, and all of the State of Arizona. It was estimated in this survey that the 1960 power requirements of the area would amount to about 31 billion kilowatt-hours and 6,430,000 kilowatts. By 1970 the requirements were estimated to amount to about 40 billion kilowatt-hours and 8,630,000 kilowatts. These capacity requirements estimated for 1960 and 1970 exceed the supply which was then available and scheduled by 2,400,000 kilowatts and 5,200,000 kilowatts, respectively. Further studies made since the completion of the 1950 report indicate that the estimate contained in it may be too conservative.

Senator MALONE. How much conservative?

Mr. BELL. The actual requirements in 1951 were 2 billion greater over the year 1950. We have estimated this year, 1952, the growth will amount to 1,700,000,000 kilowatt-hours more than 1951.

Senator MALONE. Those are rather impressive figures.

Mr. BELL. Yes, sir, they are. The load growth in the lower-basin market area from 1945 to 1950 averaged about 1 billion kilowatt-hours a year and based on those figures which I just stated it is probable that the annual increase will be even greater for the decade 1950 to 1960. Therefore, it appears obvious that the energy output of the proposed Bridge Canyon project could be absorbed as soon as it became available.

Senator MALONE. In other words, the contracts could be made almost immediately for the available supply, just as we did on the Hoover Dam—then Boulder Dam—setup, when it was required that firm contracts for power be consummated before construction was started. That could be done in the case of Bridge Canyon.

Mr. BELL. Yes, sir, it appears that the energy growth is high enough in the area that the output of Bridge Canyon could be absorbed as fast as it becomes available. The only other information I have is in regard to this rate of growth which was mentioned the other day is, according to our data, for the 6-year period ending with 1951, the annual rate of energy growth in this lower-basin area amounted to 8.2 percent, compounded annually for those 6 years. I think that is all that I have to offer.

Senator MALONE. Would you like to offer your statement and your figures as an exhibit for the record?

Mr. BELL. Yes, sir; I would. I have copies here which I can supply you and I also would like to offer copies of this 1950 report which I mentioned, as an exhibit.

Senator MALONE. Do you have it with you?

Mr. BELL. Yes, sir; I left copies with Mr. Alfred Merritt Smith.

Senator MALONE. Do you have the copies of the Federal Power Commission report, Tom?

Mr. BELL. Those are the things I just laid there on the table by Mr. Smith. And these are copies of this statement.

Senator MALONE. How about copies of your tabulated work; could you furnish them for the record later, or would they be of value in your opinion?

Mr. BELL. I can supply these figures for you either now or later if you prefer.

Senator MALONE. I thought it would be better if you typed them and furnished them to the reporter, if you will secure her address. All

right, the reports of the Federal Power Commission and the statement of the San Francisco regional office, Federal Commission, by George R. Bell, dated October 11, 1952, will be accepted as exhibits of the Federal Power Commission. And then you will furnish copies of your tabulated work to the reporter.

(The matter referred to is as follows:)

STATEMENT OF THE SAN FRANCISCO REGIONAL OFFICE OF THE FEDERAL POWER COMMISSION

The Federal Power Commission through its San Francisco regional office published in May 1950 a power-market report of the lower basin of the Colorado River. The power-market area included in this survey comprised most of southern California, southern Nevada, and all of the State of Arizona.

It was estimated in this survey that the 1960 power requirements of the area would amount to about 31 billion kilowatt-hours and 6,430,000 kilowatts. The 1970 requirements were estimated at about 40 billion kilowatt-hours and 8,630,000 kilowatts.

The capacity requirements for 1960 and 1970 exceeded the supply which was available and scheduled, when the report was made, by 2,400,000 kilowatts and 5,200,000 kilowatts, respectively.

(A copy of the report is offered for the record.)

Further studies made since the completion of the 1950 report indicate that the estimates contained in it may be too conservative.

The load growth in the lower-basin market area from 1945 to 1950 averaged about 1 billion kilowatt-hours per year and it is probable that the annual increase will be even greater for the decade 1950 to 1960. Therefore, it appears that the energy output of the proposed Bridge Canyon plant could be absorbed as soon as it becomes available.

Postwar growth of electric-power loads in the lower Colorado River Basin power-market area

Year	Lower-basin power-market area	
	Energy requirements	Peak demand
	Million kilowatt-hours	*Kilowatts*
1945	12,015	2,100
1948	15,182	2,819
1949	15,999	3,045
1950	17,204	3,245
1951	[1] 19,294	3,560
1952	[2] 21,000	[2] 3,870

[1] Increase over 1945 at the rate of 8.2 percent compounded annually.
[2] Data partially estimated.

Mr. BELL. All right, Senator, I will do that.

Senator MALONE. That is all Mr. Bell, and thank you very much.

Mr. ALBERT. Senator, I represent California-Pacific Utilities, I run the electric facility at Henderson and would like to make a statement.

Senator MALONE. Come forward, and we will complete the power setup. Will you identify yourself for the record?

Mr. ALBERT. E. K. Albert, vice president and chief engineer of California-Pacific Utilities Co.

Senator MALONE. Now the California-Pacific Utilities Co.; what area does that company serve?

STATEMENT OF E. K. ALBERT, VICE PRESIDENT AND GENERAL MANAGER, CALIFORNIA-PACIFIC UTILITIES CO.

Mr. ALBERT. We serve about five States. The area that we serve in here embraces Henderson townsite and Carver Park and Victory Village on the other side of the highway. We acquired the system here from the State of Nevada on April of this year, and at that time obtained a contract for 10,000 kilowatts of capacity and 20 million kilowatt-hours per year for the requirements of the community. At that time we had about 1,100 homes here in Henderson. The requirements for the 12 months previous to the time we took over were about 17 million kilowatt-hours per year, and about 8,500 kilowatts of capacity. Since we took over, there have been 350 new homes completed and are now being served. There are 81 more homes under construction for employees of Manganese, Inc., and a new subdivision is just being started which will have some 360 more new homes. As I understand it, about a third of those have been signed up for already. In addition to that, Titanium Corp. is putting in 200 prefabricated, temporary homes for construction workers. So that within the first year that we have had the property we will have practically a 90-percent increase in customers. Our estimate is that for the 1952–53 fiscal year we will exceed our firm contract by at least 20 percent and the following year by at least 40 percent.

Senator MALONE. What would that amount to in shortage of kilowatt-hours and kilowatts?

Mr. ALBERT. Well, it would amount to for the first year about 2,000 kilowatts of capacity and about 4 million kilowatt-hours per year; the second year, about 4,000 kilowatts of capacity and about 8 million kilowatt-hours. From all practical standpoints our operation here is really just a part of the Basic operation. Most of the customers we serve are employees of Basic and as our operation grows our population and our requirements grow.

Senator MALONE. What is the name of your company?

Mr. ALBERT. California-Pacific Utilities Co.

Senator MALONE. What do you anticipate in the future, say 5 or 10 years, or are you unable to look ahead that far due to the emergency nature of some of the productions?

Mr. ALBERT. It is hard to look ahead that far, Senator, but if the predictions of some of the major companies that are operating here at Basic are good, the population should double here in the next 4 or 5 years, and with that much of an increase, our requirements will naturally double.

Senator MALONE. Then if some of our plans work out that we get increase in power in addition to the Shasta Dam power from the Central Valley and then a fair share of the Glen Canyon, Bridge Canyon power, with the commercial and civil production here there might be an extreme shortage from your standpoint in the next 10 or 15 years.

Mr. ALBERT. Yes; that is correct.

Senator MALONE. Do you have any further statement?

Mr. ALBERT. I think that is all.

Senator MALONE. I think that is very fine and very clear and if you have any supplemental statement after considering the subject, you may submit it to the committee. Is there any other local power user

here this morning? If not, we will revert to the water supply. Mr. Robinson, you may come forward and identify yourself for the record.

Mr. ROBINSON. I am Mr. T. W. Robinson, staff engineer, Water Resources Branch, United States Geological Survey, Ground Water Division.

Senator MALONE. Mr. Robinson, you have heard the testimony of the State engineer, Mr. Hugh Shamberger, yesterday, to the effect that together and in cooperation with your department you had completed an underground water survey of this area, the entire southern Nevada area. I presume it covers the active ground-water pumping area. And you heard Mr. Shamberger testify that as early as 1946 a 30,000 to 35,000 acre-foot increment water supply into this valley annually was taken out and that thereafter the ground water level steadily dropped. Now dropping at approximately 2 feet per year is creating a very dangerous condition for the existing users to say nothing of the almost impossibility of looking ahead for very much greater growth in this area. Would you take over from there and give us conclusions? Do you have a written statement that you want to read, and then make any further statement that you want to?

STATEMENT OF T. W. ROBINSON, STAFF ENGINEER, WATER RESOURCES BRANCH, UNITED STATES GEOLOGICAL SURVEY

Mr. ROBINSON. That is correct. We have not completed the ground-water studies or inventory of all of southern Nevada, but we do have a report on Las Vegas, Pahrump, and Indian Springs Valley, estimating the average annual recharge to those valleys and inventories of withdrawals for these valleys for primarily irrigation and domestic use. The report that Mr. Shamberger referred to yesterday, the published report, known as Water Resources Bulletin No. 5, entitled "Geology and Water Resources of Las Vegas, Pahrump, Indian Spring Valleys, Clark and Nye Counties, Nev." I offer this, at Mr. Shamberger's suggestion for the record.

Senator MALONE. It will be accepted as an exhibit in Mr. Shamberger's statement.

Mr. ROBINSON. To continue, the testimony Mr. Shamberger gave regarding Las Vegas Valley is essentially correct. The average annual recharge has been estimated as between 30,000 and 35,000 acre-feet annually. The inventory discharge has increased progressively since 1945 when the first one was made and the last inventory shows the withdrawals of 34,100 acre-feet of water annually.

Senator MALONE. Which is greater than the estimated inflow?

Mr. ROBINSON. It is probably greater than the estimated inflow. It is rather difficult to give those figures too exactly, they have been bracketed as between 30,000 and 35,000. In addition to the 34,100 acre-feet, which is a result of pumping, probably between 5,000 and 8,000 acre-feet of water is discharged through natural processes—that is through evaporation through the soil through use by plants.

Senator MALONE. Is there any loss through artesian wells or have they all been kept?

Mr. ROBINSON. By and large I believe that has been controlled so that the loss from leaky artesian wells now is very small.

Senator MALONE. Does Mr. Shamberger's testimony conform to your conclusion that it was a wise thing to continue allowing addi-

tional permits in order to not delay the growth of the city, Las Vegas, Pittman, and Whitney, and other towns in the same area, depending upon an auxiliary water supply in the future to save the day, to save the situation?

Mr. ROBINSON. That appears to be the only solution until additional water can be brought into the valley. At the present time it is clearly evident from the data at hand that water is being taken from storage in Las Vegas Valley.

Senator MALONE. You mean taken from storage that would continue to decrease the ground water supply and continue the annual lowering of the ground-water level. Now, what happens eventually, when that is a continual procedure?

Mr. ROBINSON. The water level will continue to drop. Many of the wells have ceased to flow or they will continue to drop which will mean a greater and greater pumping lift and eventually at some time in the future the pumping lift may become prohibitive for many industries or even for domestic use.

Senator MALONE. Of course, that prevents the future growth of an area.

Mr. ROBINSON. Yes, because the growth of an area is tied up with its water supply.

Senator MALONE. Is there any known available supply of water except the Colorado River sources, that is to say Muddy River, Virgin River and tributaries, the Colorado River and Lake Mead, which of course, is made up of Colorado River water?

Mr. ROBINSON. The only source that is close at hand and the only one that seems most logical and feasible to develop would be water from the Colorado River. There are other sources of ground water lying to the north and lying to the east but development and transportation of that water to the Las Vegas Valley would be expensive and furthermore that water is needed in the locality in which it occurs.

Senator MALONE. There would probably be some difficulty in securing this water if it is already partially appropriated in that area.

Mr. ROBINSON. Undoubtedly there would be great difficulty.

Senator MALONE. The usual water complications. Well now then, are you familiar generally with the appropriation and the facilities with which the Basic industries in this area are supplied and in the way the townsites in this area are supplied?

Mr. ROBINSON. Only in a general way, that they are supplied in this area from water pumping from Lake Mead.

Senator MALONE. Are you familiar generally with the six irrigation bills that I introduced in the United States Senate this year?

Mr. ROBINSON. No, I am not familiar with those. I should like to point out, Senator, that the ground-water supplies of southern Nevada are dependent upon precipitation within the area. The precipitation, rainfall and snowfall, is well known and is rather low. It ranges from 3 to 4 inches per year in the valleys to possibly as much as 20 to 30 inches in the mountain areas. It is the precipitation that falls within the mountains that melts in the spring of the year and the runoff percolates into the ground and recharges our ground-water reservoirs. That is the principal source for all of southern Nevada.

Senator MALONE. It falls in higher elevations and finds its way into the ground.

Mr. ROBINSON. Yes, it falls in the mountainous areas, melts, runs down the streams, reaches the edge of the mountain, percolates into the loose material and then finds its way into the valley floors.

Senator MALONE. Did you mention what the precipitation actually amounts to within this area, on say an average, or the minimum and maximum limits?

Mr. ROBINSON. The average precipitation of the valleys, I have a few figures of Las Vegas, 4.26 inches annually; Boulder, 4.17 inches; Beaty, 4.63 inches; Caliente, a little higher, 8 inches, going farther north to Mina, 3.7 inches; Searchlight, 7.88, which is about a thousand feet higher than Las Vegas, Tonapah, which is high elevation but only about 5 inches of precipitation.

Senator MALONE. You have your accepted methods of study and making estimates of the percentage of the water falling in the surrounding areas, in the higher elevations it reaches the underground supply, your accepted methods have been worked out over a long term of years?

Mr. ROBINSON. Yes; we have several methods for approaching that.

Senator MALONE. Now these irrigation bills that were introduced are numbered from 1297, the first five irrigation bills, from S. 1297 to S. 1301, inclusive, and then later I introduced another bill to irrigate what is known as the Mormon Mesa area, the most eastern area that is included in the proposed legislation. I want to submit at this time a copy of the five irrigation bills together with the discussion. They are contained in a reprint of April 9, 1951, as an exhibit in the groundwater survey and estimates. I would include in the record also, that is an exhibit—I regret I do not have a copy of it here—of Senate bill to irrigate the Mormon Mesa, as I recall about 42,000 acres in the area. (The matter referred to is as follows:)

FIVE IRRIGATION PROJECTS FOR SOUTHERN NEVADA COLORADA RIVER WATER

(Address and proposed legislation, Hon. George W. Malone of Nevada in the Senate of the United States, April 9, 1951)

FIVE PROJECTS—NOS. 1, 2, 3, 4, AND 5

Mr. MALONE. Mr. President, I am today introducing five bills for the irrigation of southern Nevada lands located near Lake Mead in Clark County, Nev.

THE FIVE NEVADA PROJECTS

Mr. President, I ask unanimous consent to have inserted in the Record as a part of my remarks the following description of the projects numbered 1 to 5, containing a gross area of 189,460 acres.

There being no objection, the matter referred to was ordered to be printed in the Record, as follows:

"Project No. 1 contains a total of 7,660 acres in the following seven areas:

"Area No. 1: 1,300 acres in the Mesquite area irrigated from the Virgin River.

"Area No. 2: 900 acres in the Bunkerville area irrigated from the Virgin River.

"Area No. 3: 60 acres below Riverside station irrigated from the Virgin River.

"Area No. 4: 1,600 acres just above Lake Mead.

"Area No. 8: 2,800 acres near St. Thomas irrigated from Lake Mead.

"Area No. 9: 600 acres in two separate tracts irrigated from Lake Mead.

"Area No. 10: 400 acres irrigated from Lake Mead.

"Project No. 2 contains a total of 20,600 acres in the following three areas:

"Areas Nos. 5 and 6: 12,000 acres in the Muddy River and Meadow Valley Wash above Glendale and below Warm Springs irrigated from Lake Mead and the Muddy River.

"Area No. 7: 8,600 acres including land now under the Muddy Valley Irrigation Co.'s canals with additional acreage irrigated from Lake Mead.

"Project No. 3 contains a total of 61,200 acres in the following two areas:

"Area No. 11: 1,200 acres, 14 miles east of Las Vegas, on a branch of the Las Vegas Wash, irrigated from Lake Mead.

Area No. 12: 60,000 acres lying in Las Vegas Wash, irrigated from Lake Mead.

"Project No. 4 contains a total of 40,000 acres in the area southwest of Boulder City:

"Area No. 16: 40,000 acres, lying approximately 5 miles southwest of Boulder City, irrigated from Lake Meade.

"Project No. 5 contains a total of 60,000 acres in the following three areas:

"Areas Nos. 13, 14, 15,: 60,000 acres, including bottom and bench land in the vicinity of Davis Dam, irrigated from the Colorada River."

Mr. MALONE. Mr. President, the five projects are shown in detail on map No. 4 which was made under my direction as State engineer of Nevada and secretary of the Colorado River Commission, published on Feburary 20, 1935. This map is included in my 1935 official report for the Colorado River Commission of Nevada, covering the period of January 1, 1927, to September 1, 1935.

THE COLORADO RIVER REPORT—1927 TO 1935

During the 8½-year period that the junior Senator from Nevada served as State engineer and engineer member and secretary of the Colorado River Commission for my State of Nevada, I directed the survey and the preparation of the "Report of the Colorada River Commission, including a study of proposed uses of power and water from Hoover (Boulder) Dam."

Mr. President, I ask unanimous consent to have printed in the Record at this point as a part of my remarks the headings of the chapters of the report numbers I to XII.

There being no objections, the matter was ordered to be printed in the Record, as follows:

"Chapter I—General Conditions at Boulder Dam.
"Chapter II—Manufactured Products and Markets.
"Chapter III—Raw Materials.
"Chapter IV—Power.
"Chapter V—Power Transmission Lines.
"Chapter VI—Nevada's Revenues From Boulder Dam Power.
"Chapter VII—Reclamation.
"Chapter VIII—Water Supply of the Colorado River.
"Chapter IX—Financial Statment.
"Chapter X—Boulder Canyon Project Act.
"Chapter XI—Colorado River Compact.
"Chapter XII—Appendix."

PUMP LIFT INCREASING

Mr. MALONE. Mr. President, the junior Senator from Nevada has delayed the introduction of proposed legislation providing for the consumptive beneficial use of the 900,000 acre-feet of the waters of the Colorada River which my State of Nevada has officially claimed, hoping that an interstate agreement between the lower basin States of Arizona, California, Nevada, New Mexico, and Utah might be consummated within a reasonable time.

The population of the Nevada area has increased more than 10 times its original number during the period subsequent to the passage of the Boulder Dam Project Act of 1928, and the underground water supply is rapidly diminishing and the pumping lift is increasing at an alarming rate.

DOMESTIC-INDUSTRIAL WATER SUPPLY IN DANGER

It is freely predicted that unless additional Colorado River water supplies can be secured from Lake Mead and tributaries that the present population and industrial activities are in serious danger of domestic and industrial water shortages. One of the larger air training bases, Nellis Field, is being utilized almost to capacity by the Air Corps, and the war industries, manufacturing and processing plants, at Henderson are being enlarged. New industries are being established.

Mr. President, the city of Las Vegas, Nev., is at this time officially trying to purchase an interest in, or gain title to, the one pumping plant from Lake Mead

furnishing domestic and industrial water to the industrial plants at Henderson, Nev. The plant can furnish approximately 33 million gallons per day, while only about 60 percent of this is needed at Henderson.

SUBSISTENCE HOMESTEADS

Mr. President, much of the land proposed to be irrigated through the medium of the five projects would be available for subsistence homesteads—that is, relatively small tracts of 2 or 3 acres up to 5, 10, or 15 acres would be made available to the thousands of workers in war industries so they might raise vegtables and other farm products to supplement their wages and to carry them over any temporary slump in peak production.

POPULATION

With the development of the proposed irrigation projects and the full utilization of power available from the Hoover Dam and the Davis Dam, as well as power which may be secured from further upstream development of the Colorado River, including Bridge Canyon, southern Nevada could quadruple its present population within a very short time. The additional irrigated acreage would simulate interest in the establishment of homes.

A population of 125,000 to 160,000 may be expected in this area within a reasonable time, with the proper utilization of the 900,000 acre-feet of water, and the power from Hoover and Davis Dams, and other power that may become available in the future.

Mr. President, I now introduce for appropriate reference and ask unanimous consent to insert in the Record at this point as a part of my remarks the Senate bills covering projects Nos. 1, 2, 3, 4, and 5. The legislation for projects Nos. 1, 2, 3, 4, and 5 are identical except the description of the lands to be irrigated and the source of the water supply.

PROJECT NO. 1

The bill (S. 1297) authorizing the construction, operation, and maintenance of works diverting water from Lake Mead and tributaries on the Virgin River, formerly a tributary of the Colorado River, together with certain appurtenant pumping plants and canals, and for other purposes, was received, read twice by its title, referred to the Committee on Interior and Insular Affairs, and ordered to be printed in the Record, as follows:

"*Be it enacted, etc.*, That Nevada-Colorado River project No. 1, for the purpose of providing essential supplies of water for municipal, domestic, and industrial uses, and for the irrigation of public and other lands within the United States, and other beneficial purposes, the Secretary of the Interior, hereinafter referred to as the Secretary subject to the terms of the Colorado River compact, is hereby authorized to construct, operate, and maintain (1) a related system of main conduits and canals, including a main canal and pumping plant or plants for diverting and carrying Colorado River water from Lake Mead; and (2) such other drainage works as may be required to effectuate the purpose of this act.

"SEC. 2. The Secretary shall have the authority to acquire, by purchase, exchange, condemnation, or otherwise, all lands, rights-of-way, and other property necessary for said purposes: *Provided*, That, anything herein contained to the contrary notwithstanding, the Secretary shall not have the authority to condemn established water rights or the water to the use of which such rights are established, or works used or necessary for the storage and delivery of such water to the use of which rights are established, or the right to substitute or exchange water without the consent of the holders of rights or those entitled to the beneficial use of such waters as may be involved in the proposed exchange.

"SEC. 3. The estimated cost of the construction of the said works shall be determined by the Secretary. The Secretary shall also determine (a) the parts of said estimated cost that can be properly allocated to flood control, navigation, fish and wildlife conservation, respectively, and any other purposes served by the project which may hereafter be made nonreimbursable by law, the sums so allocated, together with the expenses of operation and maintenance attributed by him to such purposes, to be nonreimbursable, and (b) (1) the part of the estimated cost which can properly be allocated to irrigation and probably be returned to the United States in net revenues from the delivery of water for such purposes; (2) the part of the estimated cost which can properly be allocated to municipal water supply and probably be returned to the United States; (3)

the part of the estimated cost which can properly be allocated for industrial purposes and probably be returned to the United States, and (4) the parts of the estimated cost which can properly be allocated to water supply for mining or other miscellaneous purposes and probably returned to the United States.

"Before any construction work is done or contracted for, the Secretary shall first determine that costs allocated to municipal water supply, irrigation, industrial, mining, or other miscellaneous purposes as herein provided will probably be returned to the United States: *Provided*, That the repayment period for costs so allocated shall be such reasonable period of years, but in no event to exceed 75 years, as may be determined by the Secretary.

"SEC. 4. The Secretary is authorized to supply water for municipal, domestic, irrigation, industrial, and mining purposes in accordance with the provisions of this act and the Federal reclamation laws.

"SEC. 5. Contracts for the delivery of water for irrigation purposes shall provide for the delivery of such water at an identical price per acre-foot at the several points of delivery of water from the main canal and conduits herein authorized, and from such other points of delivery as the Secretary may designate. Such contracts shall be made with the State of Nevada, or with persons, firms, public or private corporations, irrigation, mining, industrial, or other districts, municipalities, or other political subdivisions thereof, in accordance with the reclamation law. No person shall have or be entitled to have the use, for any purpose, of any water delivered hereunder except by contract made as herein stated.

"SEC. 6. The works provided for by the first section of this act shall be used: First, for irrigation and domestic uses; and second, for industrial and mining purposes, and satisfaction of present perfected water rights. The title to all works herein authorized shall remain in the United States until transferred to municipal, irrigation, industrial, or mining districts, as provided or may hereinafter be provided by Federal reclamation law, and the United States shall, until otherwise provided by law, control, manage, and operate the same: *Provided*, That the Secretary may in discretion enter into arrangements for the operation or use of a unit or units of said works with the State of Nevada or any irrigation district, reclamation project, industrial or mining district organized under State law, or other subdivision or agency thereof.

"SEC. 7. The rights of the United States in and to the waters of the Colorado River and its tributaries for the use of which the works herein authorized are incidental, convenient, or necessary, as well as the rights of those claiming under the United States, shall be subject to and controlled by the Colorado River compact.

"SEC. 8. The United States in constructing, managing, and operating the works herein authorized, including the appropriation, delivery, and use of water for irrigation, domestic, industrial, mining, or other uses, and all users of water thus delivered and all users and appropriators of water carried by said canals, including all permittees, licensees, and contractees, of the United States, or any of its agencies, shall observe and be subject to and controlled, anything to the contrary herein notwithstanding, by the terms of the Colorado River compact and by the laws of the State of Nevada governing water rights wherever the same may be applicable.

"SEC. 9. Nothing herein shall be construed as modifying or affecting any of the provisions of the treaty between the United States of America and the United Mexican States signed at Washington, D. C., February 3, 1944, relating to the utilization of the waters of the Colorado River and other rivers, as amended and supplemented by the protocol dated November 14, 1944, and the understanding recited in the Senate resolution of April 18, 1945, advising and consenting to ratification thereof.

"SEC. 10. This act shall be deemed a supplement to the reclamation law, which said reclamation law shall govern the construction, operation, and management of the works herein authorized, except as otherwise herein provided.

"SEC. 11. Nothing herein shall be construed as interfering with such rights as the State of Nevada or any other State now has either to the waters within its borders or to adopt such policies and enact such laws as it may deem necessary with respect to the appropriation, control, and use of waters within its borders, except as modified by the Colorado River compact or any other interstate agreement.

"SEC. 12. If any State or States within 6 months after the effective date of this act shall begin a suit or suits in the Supreme Court of the United States to determine the right to the use of water for diversion from the main stream

of the Colorado River through pumping plants and necessary works to be constructed pursuant to this act for beneficial consumptive use in Nevada, and to adjudicate claims of right asserted by such State or States or by any other State or States, under the Colorado River compact, the Boulder Canyon Project Act (45 Stat. 1057), the California Self-Limitation Act (Cal. Stat. 1929, ch. 16), and the Boulder Canyon Project Adjustment Act (54 Stat. 774), consent is hereby given to the joinder of the United States of America as a party in such action or actions. Any State of the Colorado River Basin may intervene or be impleaded in such suit or suits. Any such claims of right affected by the project herein authorized and asserted by any defendant State, impleaded State, or intervening State under said compact and statute, or by the United States, may be adjudicated in such action. In any such suit or suits process directed against the United States shall be served upon the Attorney General of the United States.

"SEC. 13. There are hereby authorized to be appropriated, out of any moneys in the Treasury not otherwise appropriated, such sums as may be necessary to carry out the provisions of this act: *Provided*, That no moneys appropriated under the authority of this act shall be expended for the construction of works authorized by this act which are required solely for the purpose of diverting, transporting, and delivering water from Lake Mead and tributaries or the main stream of the Colorado River for beneficial consumptive use in Nevada, during the period of 6 months after the enactment of this act and during the pendency of any be joined as a party under and by virtue of the consent granted in section 12 of this act. The pendency of a motion for leave to suit or suits in which the United States shall file a bill of complaint shall be considered pendency of a suit or suits for the purposes of this act.

"SEC. 14. Project No. 1 contains 7,660 acres including the following areas:

"Area No. 1: 1,300 acres in the Mesquite area to be irrigated from the Virgin River.

"Area No. 2: 900 acres in the Bunkerville area to be irrigated from the Virgin River.

"Area No. 3: 60 acres below Riverside station to be irrigated from the Virgin River.

"Area No. 4: 1,600 acres just above Lake Mead on the Virgin River.

"Area No. 8: 2,800 acres near St. Thomas to be irrigated from Lake Mead.

"Area No. 9: 600 acres in two separate tracts to be irigated from Lake Mead.

"Area No. 10: 400 acres to be irrigated from Lake Mead.

"SEC. 15. Construction shall not commence, and no contracts therefor shall be entered into, on any portion of the project hereby authorized, if a Federal agency having jurisdiction over the allocation of materials and labor, or either, finds that the materials and labor, or either, necessary for the construction of the project are needed for national defense and by appropriate general regulation, order, or otherwise, suspends or prohibits their use for construction of the project hereby authorized, until such suspension or prohibition is rescinded or expires, or control over the allocation of such materials or labor is no longer exercised."

Mr. MALONE. Mr. President, projects numbered 2 to 5, inclusive, are contained in exactly the same type of bill, except the difference in the areas, and the difference in the pump lift, which varies from perhaps 25 feet to as much as 850 feet, with no works necessary, except pumping plants. Transmission lines and other facilities to furnish power for pumping and for other purposes is available at this time, mostly crossing the area that would be irrigated through the development of the projects or very near to such areas.

PROJECT NO. 2

The bill (S. 1298) authorizing the construction, operation, and maintenance of works diverting water from Lake Mead and tributaries formed by Hoover Dam, together with certain appurtenant pumping plants and canals, and for other purposes, introduced by Mr. Malone, was received, read twice by its title, referred to the Committee on Interior and Insular Affairs, and ordered to be printed in the Record, as follows:

"*Be it enacted, etc.*, That Nevada-Colorado River project No. 2, for the purpose of providing essential supplies of water for municipal, domestic, and industrial uses, and for the irrigation of public and other lands within the United States, and other beneficial purposes, the Secretary of the Interior, hereinafter referred to as the Secretary, subject to the terms of the Colorado River com-

pact, is hereby authorized to construct, operate, and maintain (1) a related system of main conduits and canals, including a main canal and pumping plant or plants for diverting and carrying Colorado River water from Lake Mead; and (2) such other canals, canal improvements, laterals, pumping plants, and drainage works as may be required to effectuate the purposes of this act.

"SEC. 2. The Secretary shall have the authority to acquire, by purchase, exchange, condemnation, or otherwise, all lands, rights-of-way, and other property necessary for said purposes: *Provided*, That anything herein contained to the contrary notwithstanding, the Secretary shall not have the authority to condemn established water rights or the water to the use of which such rights are established, or works used or necessary for the storage and delivery of such water to the use of which such rights are established, or the right to substitute or exchange water without the consent of the holders of rights or those entitled to the beneficial use of such waters as may be involved in the proposed exchange.

"SEC. 3. The estimated cost of the construction of the said works shall be determined by the Secretary. The Secretary shall also determine (a) the parts of said estimated cost that can be properly allocated to flood control, navigation and wildlife conservation, respectively, and any other purposes served by the project, which may hereafter be made nonreimbursable by law, the sums so allocated, together with the expenses of operation and maintenance attributed by him to such purposes, to be nonreimbursable, and (b) (1) the part of the estimated cost which can properly be allocated to irrigation and probably be returned to the United States in net revenues from the delivery of water for such purposes; (2) the part of the estimated cost which can properly be allocated to municipal water supply and probably be returned to the United States; (3) the part of the estimated cost which can properly be allocated for industrial purposes and probably be returned to the United States; and (4) the part of the estimated cost which can properly be allocated to water supply for mining or other miscellaneous purposes and probably be returned to the United States.

"Before any construction work is done or contracted for, the Secretary shall first determine that costs allocated to municipal water supply, irrigation, industrial, mining, or other miscellaneous purposes as herein provided will probably be returned to the United States: *Provided*, That the repayment period for costs so allocated shall be such reasonable period of years, but in no event to exceed 75 years, as may be determined by the Secretary.

"SEC. 4. The Secretary as authorized to supply water for municipal, domestic, irrigation, industrial, and mining purposes in accordance with the provisions of this act and the Federal reclamation laws.

"SEC. 5. Contracts for the delivery of water for irrigation purposes shall provide for the delivery of such water at an identical price per acre-foot at the several points of delivery of water from the main canals and conduits herein authorized, and from such other points of delivery as the Secretary may designate. Such contracts shall be made with the State of Nevada, or with persons, firms, public or private corporations, irrigation, mining, industrial or other districts, municipal or other political subdivisions thereof, in accordance with the reclamation law. No person shall have or be entitled to have the use for any purpose of any water delivered hereunder except by contract made as herein stated.

"SEC. 6. The works provided for by the first section of this act shall be used: First, for irrigation and domestic uses; and second, for industrial and mining purposes, and satisfaction of present perfected water rights. The title to all works herein authorized shall remain in the United States until transferred to municipal, irrigation, industrial or mining districts, as provided or may hereinafter be provided by Federal reclamation law, and the United States shall until otherwise provided by law control, manage, and operate the same: *Provided*, That the Secretary may in his discretion enter into arrangement for the operation or use of a unit or units of said work with the State of Nevada, or any irrigation district, reclamation project, industrial or mining district organized under State law, or other subdivision or agency thereof.

"SEC. 7. The rights of the United States in and to the waters of the Colorado River and its tributaries for the use of which the works herein authorized are incidental, convenient, or necessary as well as the rights of those claiming under the United States shall be subject to and controlled by the Colorado River compact.

"SEC. 8. The United States in constructing, managing, and operating the works herein authorized, including the appropriation, delivery, and use of water for irrigation, domestic, industrial, mining, or other uses, and all users of water

thus delivered and all users and appropriators of water carried by said canals, including all permittees, licensees, and contractees of the United States, or any of its agencies, shall observe and be subject to and controlled, anything to the contrary herein notwithstanding, by the terms ofthe Colorado River compact and by the laws of the State of Nevada governing water rights wherever the same may be applicable.

"SEC. 9. Nothing herein shall be construed as modifying or affecting any of the provisions of the treaty between the United States of America and the United Mexican States signed at Washington, D. C., February 3, 1944, relating to the utilization of the waters of the Colorado River and other rivers as amended and supplemented by the protocol dated November 14, 1944, and the understanding recited in the Senate resolution of April 18, 1945, advising and consenting to ratification thereof.

"SEC. 10. This act shall be deemed a supplement to the reclamation law, which said reclamation law shall govern the construction, operation, and management of the works herein authorized except as otherwise herein provided.

"SEC. 11. Nothing herein shall be construed as interfering with such rights as the State of Nevada or any other State now has either to the waters within its borders or to adopt such policies and enact such laws as it may deem necessary with respect to the appropriation, control, and use of waters within its borders, except as modified by the Colorado River compact or any other interstate agreement.

"SEC. 12. If any State or States within 6 months after the effective date of this act shall begin a suit or suits in the Supreme Court of the United States to determine the right to the use of water for diversion from the main stream of the Colorado River through pumping plants and necessary works to be constructed pursuant to this act for beneficial consumptive use in Nevada, and to adjudicate claims of right asserted by such State or States or by any other State or States, under the Colorado River compact, the Boulder Canyon Project Act (45 Stat. 1057), the California Self-Limitation Act (Cal. Stat. 1929, ch. 16), and the Boulder Canyon Project Adjustment Act (54 Stat. 774), consent is hereby given to the joinder of the United States of America as a party in such action or actions. Any State of the Colorado River Basin may intervene or be impleaded in such suit or suits. Any such claims or right affected by the project herein authorized and asserted by any defendant State, impleaded State, or intervening State under said compact and statutes, or by the United States, may be adjudicated in such action. In any such suit or suits process directed against the United States shall be served upon the Attorney General of the United States.

"SEC. 13. There are hereby authorized to be appropriated, out of any moneys in the Treasury not otherwise appropriated, such sums as may be necessary to carry out the provisions of this act: *Provided*, That no moneys appropriated under the authority of this act shall be expended for the construction of works authorized by this act which are required solely for the purpose of diverting, transporting, and delivering water from Lake Mead and tributaries, the main stream of the Colorado River for beneficial consumptive use in Nevada, during the period of 6 months after the enactment of this act and during the pendency of any suit or suits in which the United States shall be joined as a party under and by virtue of the consent granted in section 12 of this act. The pendency of a motion for leave to file a bill of complaint shall be considered pendency of a suit or suits for the purposes of this act.

"SEC. 14. PROJECT NO. 2 contains a total of 20,600 acres in the following three areas:

"Areas No. 5 and 6: 12,000 acres in the Muddy River and Meadow Valley Wash above Glendale and below Warm Springs to be irrigated from Lake Mead and the Muddy River.

"Area No. 7: 8,600 acres including land now under the Muddy Valley Irrigation Company's canals with additional acreage to be irrigated from Lake Mead.

"SEC. 15. Construction shall not commence, and no contracts therefor shall be entered into, on any portion of the project hereby authorized, if a Federal agency having jurisdiction over the allocation of materials and labor, or either, finds that the materials and labor, or either, necessary for the construction of the project are needed for national defense and by appropriate general regulation, order or otherwise suspends or prohibits their use for construction of the project hereby authorized, until such suspension or prohibition is rescinded or expires or control over the allocation of such materials or labor is no longer exercised."

PROJECT NO. 3

The bill (S. 1299) authorizing the construction, operation, and maintenance of works diverting water from Lake Mead formed by Hoover Dam, together with certain appurtenant pumping and canals, and for other purposes, introduced by Mr. Malone, was received, read twice by its title, referred to the Committee on Interior and Insular Affairs, and ordered to be printed in the Record as follows:

"*Be it enacted, etc.*, That Nevada-Colorado River project No. 3, for the purpose of providing essential supplies of water for municipal, domestic, and industrial uses, and for the irrigation of public and other lands within the United States, and other beneficial purposes, the Secretary of the Interior, hereinafter referred to as the Secretary, subject to the terms of the Colorado River compact, is hereby authorized to construct, operate, and maintain (1) a related system of main conduits and canals, including a main canal and pumping plant or plants for diverting and carrying Colorado River water from Lake Mead; and (2) such other canals, canal improvements, laterals, pumping plants, and drainage works as may be required to effectuate the purposes of this act.

"SEC. 2. The Secretary shall have the authority to acquire, by purchase, exchange, condemnation, or otherwise, all lands, rights-of-way, and other property necessary for said purposes: *Provided*, That, anything herein contained to the contrary notwithstanding, the Secretary shall not have the authority to condemn established water rights or the water to the use of which such rights are established, or works used or necessary for the storage and delivery of such water to the use of which rights are established, or the right to substitute or exchange water without the consent of the holders of rights or those entitled to the beneficial use of such waters as may be involved in the proposed exchange.

"SEC. 3. The estimated cost of the construction of the said works shall be determined by the Secretary. The Secretary shall also determine (a) the parts of said estimated cost that can be properly allocated to flood control, navigation, fish and wildlife conservation, respectively, and any other purposes served by the project which may hereafter be made nonreimbursable by law, the sums so allocated, together with the expenses of operation and maintenance attributed by him to such purposes, to be nonreimbursable, and (b) (1) the part of the estimated cost which can properly be allocated to irrigation and probably be returned to the United States in net revenues from the delivery of water for irrigation purposes; (2) the part of the estimated cost which can properly be allocated to irrigation and probably be returned to the United States by revenues derived from sources other than the delivery of water for irrigation purposes; (3) the part of the estimated cost which can properly be allocated to municipal water supply and probably be returned to the United States; (4) the part of the estimated cost which can properly be allocated for industrial purposes and probably be returned to the United States; and (5) the part of the estimated cost which can properly be allocated to water supply for mining or other miscellaneous purposes and probably be returned to the United States.

"Before any construction work is done or contracted for, the Secretary shall first determine that costs allocated to municipal water supply, irrigation, industrial, mining, or other miscellaneous purposes as herein provided will probably be returned to the United States: *Provided*, That the repayment period for costs so allocated shall be such reasonable period of years, but in no event to exceed 75 years, as may be determined by the Secretary.

"SEC. 4. The Secretary is authorized to supply water for municipal, domestic, irrigation, industrial, and mining purposes in accordance with the provisions of this act and the Federal reclamation laws.

"SEC. 5.. Contracts for the delivery of water for irrigation purposes shall provide for the delivery of such water at an identical price per acre-foot at the several points of delivery of water from the main canals and conduits herein authorized, and from such other points of delivery as the Secretary may designate. Such contracts shall be made with the State of Nevada, or with persons, firms, public or private corporations, irrigation, mining, industrial or other districts, municipal or other political subdivisions thereof, in accordance with the reclamation law. No person shall have or be entitled to have the use for any purpose of any water delivered hereunder except by contract made as herein stated.

"SEC. 6. The works provided for by the first section of this act shall be used: First, for irrigation and domestic uses; and second, for industrial and mining purposes, and satisfaction of present perfected water rights. The title to all works herein authorized shall remain in the United States until transferred

to municipal, irrigation, industrial or mining districts, as provided or may hereinafter be provided by Federal reclamation law, and the United States shall until otherwise provided by law control, manage, and operate the same: *Provided*, That the Secretary may in his discretion enter into arrangements for the operation or use of a unit or units of said works with the State of Nevada, or any irrigation district, reclamation project, industrial or mining district organized under State law, or other subdivision or agency thereof.

"SEC. 7. The rights of the United States in and to the waters of the Colorado River and its tributaries for the use of which the works herein authorized are incidental, convenient, or necessary as well as the rights of those claiming under the United States shall be subject to and controlled by the Colorado River compact.

"SEC. 8. The United States in constructing, managing, and operating the works herein authorized, including the appropriation, delivery, and use of water for irrigation, domestic, industrial, mining, or other uses, and all users of water thus delivered and all users and appropriators of water carried by said canals, including all permittees, licensees, and contractees of the United States, or any of its agencies, shall observe and be subject to and controlled, anything to the contrary herein notwithstanding, by the terms of the Colorado River compact and by the laws of the State of Nevada governing water rights wherever the same may be applicable.

"SEC. 9. Nothing herein shall be construed as modifying or affecting any of the provisions of the treaty between the United States of America and the United Mexican States signed at Washington, D. C., February 3, 1944, relating to the utilization of the waters of the Colorado River and other rivers as amended and supplemented by the protocol dated November 14, 1944, and the understanding recited in the Senate resolution of April 18, 1945, advising and consenting to ratification thereof.

"SEC. 10. This act shall be deemed a supplement to the reclamation law, which said reclamation law shall govern the construction, operation, and management of the works herein authorized except as otherwise herein provided.

"SEC. 11. Nothing herein shall be construed as interfering with such rights as the State of Nevada or any other State now has either to the waters within its borders or to adopt such policies and enact such laws as it may deem necessary with respect to the appropriation, control, and use of waters within its borders, except as modified by the Colorado River compact or any other interstate agreement.

"SEC. 12. If any State or States within 6 months after the effective date of this act shall begin a suit or suits in the Supreme Court of the United States to determine the right to the use of water for diversion from the main stream of the Colorado River through pumping plants and necessary works to be constructed pursuant to this act for beneficial consumptive use in Nevada, and to adjudicate claims of right asserted by such State or States or by any other State or States, under the Colorado River compact, the Boulder Canyon Project Act (45 Stat. 1057), the California Self-Limitation Act (Cal. Stat. 1929, ch. 16), and the Boulder Canyon Project Adjustment Act (54 Stat. 774), consent is hereby given to the joinder of the United States of America as a party in such action or actions. Any State of the Colorado River Basin may intervene or be impleaded in such suit or suits. Any such claims of right affected by the project herein authorized and asserted by any defendant State, impleaded State, or intervening State under said compact and statutes, or by the United States may be adjudicated in such action. In any such suit or suits process directed against the United States shall be served upon the Attorney General of the United States.

"SEC. 13. There are hereby authorized to be appropriated, out of any moneys in the Treasury not otherwise appropriated, such sums as may be necessary to carry out the provisions of this act: *Provided*, That no moneys appropriated under the authority of this act shall be expended for the construction of works authorized by this act which are required solely for the purpose of diverting, transporting, and delivering water from Lake Mead and its tributaries or the main stream of the Colorado River for beneficial consumptive use in Nevada, during the period of 6 months after the enactment of this act and during the pendency of any suit or suits in which the United States shall be joined as a party under and by virtue of the consent granted in section 12 of this act. The pendency of a motion for leave to file a bill of complaint shall be considered pendency of a suit or suits for the purposes of this act.

"SEC. 14. Project No. 3 contains a total of 61,200 acres in the following two areas:

"Area No. 11: 1,200 acres 14 miles east of Las Vegas on a branch of the Las Vegas Wash to be irrigated from Lake Mead.

"Area No. 12: 60,000 acres lying in Las Vegas Wash to be irrigated from Lake Mead.

"SEC. 15. Construction shall not commence, and no contracts therefor shall be entered into, or any portion of the project hereby authorized, if a Federal agency having jurisdiction over the allocation of materials and labor, or either, finds that the materials and labor, or either, necessary for the construction of the project are needed for national defense and by appropriate general regulation, order, or otherwise suspends or prohibits their use for construction of the project hereby authorized, until such suspension or prohibition is rescinded or expires or control over the allocation of such materials or labor is no longer exercised."

PROJECT NO. 4

The bill (S. 1300) authorizing the construction, operation, and maintenance of works diverting water from Lake Mead above Hoover Dam, together with certain appurtenant pumping plants and canals, and for other purposes, introduced by Mr. Malone, was received, read twice by its title, referred to the Committee on Interior and Insular Affairs, and ordered to be printed in the Record, as follows:

"*Be it enacted, etc.*, That Nevada Colorado River project No. 4, for the purpose of providing essential supplies of water for municipal, domestic, and industrial uses, and for the irrigation of public and other lands within the United States, and other beneficial purposes, the Secretary of the Interior, hereinafter referred to as the Secretary, subject to the terms of the Colorado River compact, is hereby authorized to construct, operate, and maintain (1) a related system of main conduits and canals, including a main canal and pumping plant or plants for diverting and carrying Colorado River water from Lake Mead; and (2) such other canals, canal improvements, laterals, pumping plants, and drainage works as may be required to effectuate the purposes of this act.

"SEC. 2. The Secretary shall have the authority to acquire by purchase, exchange, condemnation, or otherwise all lands, rights-of-way, and other property necessary for said purposes: *Provided*, That anything herein contained to the contrary notwithstanding the Secretary shall not have the authority to condemn established water rights or the water to the use of which such rights are established, or works used or necessary for the storage and delivery of such water to the use of which rights are established, or the right to substitute or exchange water without the consent of the holders of rights or those entitled to the beneficial use of such waters as may be involved in the proposed exchange.

"SEC. 3. The estimated cost of the construction of the said works shall be determined by the Secretary. The Secretary shall also determine (a) the parts of said estimated cost that can be properly allocated to flood control, navigation, fish and wildlife conservation, respectively, and any other purposes served by the project which may hereafter be made nonreimbursable by law, the sum so allocated, together with the expenses of operation and maintenance attributed by him to such purposes, to be nonreimbursable, and (b) (1) the part of the estimated cost which can properly be allocated to irrigation and probably be returned to the United States in net revenues from the delivery of water for irrigation purposes; (2) the part of the estimated cost which can properly be allocated to irrigation and probably be returned to the United States by revenues derived from sources other than the delivery of water for irrigation purposes; (3) the part of the estimated cost which can properly be allocated to municipal water supply and probably be returned to the United States; (4) the part of the estimated cost which can properly be allocated for industrial purposes and probably be returned to the United States; (5) the part of the estimated cost which can properly be allocated to water supply or mining or other miscellaneous purposes and probably be returned to the United States.

"Before any construction work is done or contracted for the Secretary shall first determine that costs allocated to municipal water supply, irrigation, industrial, mining, or other miscellaneous purposes as herein provided will probably be returned to the United States: *Provided*, That the repayment period for costs so allocated shall be such reasonable period of years but in no event to exceed 75 years, as may be determined by the Secretary.

"SEC. 4. The Secretary is authorized to supply water for municipal, domestic, irrigation, industrial, and mining purposes in accordance with the provisions of this act and the Federal reclamation laws.

"SEC. 5. Contracts for the delivery of water for irrigation purposes shall provide for the delivery of such water at an identical price per acre-foot at the several points of delivery of water from the main canals and conduits herein authorized, and from such other points of delivery as the Secretary may designate. Such contracts shall be made with the State of Nevada, or with persons, firms, public or private corporations, irrigation, mining, industrial or other districts, municipal or other political subdivisions thereof, in accordance with the reclamation law. No person shall have or be entitled to have the use for any purpose of any water delivered hereunder except by contract made as herein stated.

"SEC. 6. The works provided for by the first section of this act shall be used: First, for irrigation and domestic uses; and second, for industrial and mining purposes, and satisfaction of present perfected water rights. The title to all works herein authorized shall remain in the United States until transferred to municipal, irrigation, industrial or mining districts, as provided or may hereinafter be provided by Federal reclamation law, and the United States shall until otherwise provided by law control, manage, and operate the same: *Provided*, That the Secretary may in his discretion enter into arrangements for the operation or use of a unit or units of said works with the State of Nevada, or any irrigation district, reclamation project, industrial or mining district organized under State law, or other subdivision or agency thereof.

"SEC. 7. The rights of the United States in and to the waters of the Colorado River and its tributaries for the use of which the works herein authorized are incidental, convenient, or necessary as well as the rights of those claiming under the United States shall be subject to and controlled by the Colorado River compact.

"SEC. 8. The United States in constructing, managing, and operating the works herein authorized, including the appropriation, delivery, and use of water for irrigation, domestic, industrial, mining, or other uses, and all users of water thus delivered and all users and appropriators of water carried by said canals, including all permittees, licensees, and contractees of the United States, or any of its agencies, shall observe and be subject to and controlled, anything to the contrary herein notwithstanding, by the terms of the Colorado River compact and by the laws of the State of Nevada governing water rights wherever the same may be applicable.

"SEC. 9. Nothing herein shall be construed as modifying or affecting any of the provisions of the treaty between the United States of America and the United Mexican States signed at Washington, D. C., February 3, 1944, relating to the utilization of the waters of the Colorado River and other rivers, as amended and supplemented by the protocol dated November 14, 1944, and the understanding recited in the Senate resolution of April 18, 1945, advising and consenting to ratification thereof.

"SEC. 10. This act shall be deemed a supplement to the reclamation law, which said reclamation law shall govern the construction, operation, and management of the works herein authorized except as otherwise herein provided.

"SEC. 11. Nothing herein shall be construed as interfering with such rights as the State of Nevada or any other State now has either to the waters within its borders or to adopt such policies and enact such laws as it may deem necessary with respect to the appropriation, control, and use of waters within its borders, except as modified by the Colorado River compact or any other interstate agreement.

"SEC. 12. If any State or States within 6 months after the effective date of this act shall begin a suit or suits in the Supreme Court of the United States to determine the right to the use of water for diversion from the main stream of the Colorado River through pumping plants and recovery works to be constructed pursuant to this act for beneficial consumptive use in Nevada, and to adjudicate claims of right asserted by such State or States or by any other State or States, under the Colorado River compact, the Boulder Canyon Project Act (45 Stat. 1057), the California Self-Limitation Act (Cal. Stat. 1929, ch. 16), and the Boulder Canyon Project Adjustment Act (54 Stat. 774), consent is hereby given to the joinder of the United States of America as a party in such action or actions. Any State of the Colorado River Basin may intervene or be impleaded in such suit or suits. Any such claims of right affected by the project herein authorized and asserted by any defendant State, impleaded State, or intervening State under said compact and statutes, or by the United States may be adjudicated in such action. In any such suit or suits process directed against the United States shall be served upon the Attorney General of the United States.

"SEC. 13. There are hereby authorized to be appropriated, out of any moneys

in the Treasury not otherwise appropriated, such sums as may be necessary to carry out the provisions of this act: *Provided*, That no moneys appropriated under the authority of this act shall be expended for the construction of works authorized by this act which are required solely for the purposes of diverting, transporting, and delivering water from Lake Mead and tributaries or the main stream of the Colorado River for beneficial consumptive use in Nevada, during the period of 6 months after the enactment of this act and during the pendency of any suit or suits in which the United States shall be joined as a party under and by virtue of the consent granted in section 12 of this act. The pendency of a motion for leave to file a bill of complaint shall be considered pendency of a suit or suits for the purposes of this act.

"SEC. 14. Project No. 4 contains a total of 40,000 acres in the area southwest of Boulder City:

"Area No. 16: 40,000 acres lying approximately 5 miles southwest of Boulder City to be irrigated from Lake Mead.

"SEC. 15. Construction shall not commence, and no contracts therefor shall be entered into, on any portion of the project hereby authorized, if a Federal agency having jurisdiction over the allocation of materials and labor, or either, finds that the materials and labor, or either, necessary for the construction of the project are needed for national defense and by appropriate general regulation, order or otherwise suspends or prohibits their use for construction of the project hereby authorized, until such suspension or prohibition is rescinded or expires or control over the allocation of such materials or labor is no longer exercised."

PROJECT NO. 5

The bill (S. 1301) authorizing the construction, operation, and maintenance of works diverting water from the main stream of the Colorado River above Davis Dam, together with certain appurtenant pumping plants and canals, and for other purposes, introduced by Mr. MALONE was received, read twice by its title, referred to the Committee on Interior and Insular Affairs, and ordered to be printed in the Record, as follows:

"*Be it enacted, etc.*, That Nevada Colorado River project No. 5, for the purposes of providing essential supplies of water for municipal, domestic, and industrial uses, and for the irrigation of public and other lands within the United States, and other beneficial purposes, the Secretary of the Interior, hereinafter referred to as the Secretary, subject to the terms of the Colorado River compact, is hereby authorized to construct, operate, and maintain (1) a related system of main conduits and canals, including a main canal and pumping plant or plants for diverting and carrying Colorado River water from Lake Mead; and (2) such other canals, canal improvements, laterals, pumping plants, and drainage works as may be required to effectuate the purposes of this act.

"SEC. 2. The Secretary shall have the authority to acquire, by purchase, exchange, condemnation, or otherwise, all lands, rights-of-way, and other property necessary for said purposes: *Provided*, That, anything herein contained to the contrary notwithstanding, the Secretary shall not have the authority to condemn established water rights or the water to the use of which such rights are established, or works used or necessary for the storage and delivery of such water to the use of which rights are established, or the right to substitute or exchange water without the consent of the holders of rights or those entitled to the beneficial use of such waters as may be involved in the proposed exchange.

"SEC. 3. The estimated cost of the construction of the said works shall be determined by the Secretary. The Secretary shall also determine (a) the parts of said estimated cost that can be properly allocated to flood control, navigation, fish and wildlife conservation, respectively, and any other purposes served by the project which may hereafter be made nonreimbursable by law, the sums so allocated, together with the expenses of operation and maintenance attributed by him to such purposes, to be nonreimbursable, and (b) (1) the part of the estimated cost which can properly be allocated to irrigation and probably be returned to the United States in net revenues from the delivery of water for irrigation purposes; (2) the part of the estimated cost which can properly be allocated to irrigation and probably be returned to the United States by revenues derived from sources other than the delivery of water for irrigation purposes; (3) the part of the estimated cost which can properly be allocated to municipal water supply and probably be returned to the United States; (4) the part of the estimated cost which can properly be allocated for industrial purposes and probably be returned to the United States; and (5) the part of the estimated cost

which can properly be allocated to water supply for mining or other miscellaneous purposes and probably be returned to the United States.

"Before any construction work is done or contracted for, the Secretary shall first determine that costs allocated to municipal water supply, irrigation, industrial, mining, or other miscellaneous purposes as herein provided will probably be returned to the United States: *Provided*, That the repayment period for costs so allocated shall be such reasonable period of years, but in no event to exceed 75 years, as may be determined by the Secretary.

"SEC. 4. The Secretary is authorized to supply water for municipal, domestic, irrigation, industrial and mining purposes in accordance with the provisions of this act and the Federal reclamation laws.

"SEC. 5. Contracts for the delivery of water for irrigation purposes shall provide for the delivery of such water at an identical price per acre-foot at the several points of delivery of water from the main canals and conduits herein authorized, and from such other points of delivery as the Secretary may designate. Such contracts shall be made with the State of Nevada, or with persons, firms, public or private corporations, irrigation, mining, industrial or other districts, municipal or other political subdivisions thereof, in accordance with the reclamation law. No person shall have or be entitled to have the use for any purpose of any water delivered hereunder except by contract made as herein stated.

"SEC. 6. The works provided for by the first section of this act shall be used: First, for irrigation and domestic uses; and second, for industrial and mining purposes, and satisfaction of present perfected water rights. The title to all works herein authorized shall remain in the United States until transferred to municipal, irrigation, industrial, or mining districts, as provided or may hereinafter be provided by Federal reclamation law, and the United States shall until otherwise provided by law control, manage, and operate the same: *Provided*, That the Secretary may, in his discretion, enter into arrangements for the operation or use of a unit or units of said works with the State of Nevada, or any irrigation district, reclamation project, industrial or mining district organized under State law, or other subdivision or agency thereof.

"SEC. 7. The rights of the United States in and to the waters of the Colorado River and its tributaries for the use of which the works herein authorized are incidental, convenient, or necessary as well as the rights of those claiming under the United States shall be subject to and controlled by the Colorado River compact.

"SEC. 8. The United States in constructing, managing, and operating the works herein authorized, including the appropriation, delivery, and use of water for irrigation, domestic, industrial, mining, or other uses, and all users of water thus delivered and all users and appropriators of water carried by said canals, including all permittees, licensees, and contractees of the United States, or any of its agencies, shall observe and be subject to and controlled, anything to the contrary herein notwithstanding, by the terms of the Colorado River compact and by the laws of the State of Nevada governing water rights wherever the same may be applicable.

"SEC. 9. Nothing herein shall be construed as modifying or affecting any of the provisions of the treaty between the United States of America and the United Mexican States signed at Washington, D. C., February 3, 1944, relating to the utilization of the waters of the Colorado River and other rivers as amended and supplemented by the protocol dated November 14, 1944, and the understanding recited in the Senate resolution of April 18, 1945, advising and consenting to ratification thereof.

"SEC. 10. This act shall be deemed a supplement to the reclamation law, which said reclamation law shall govern the construction, operation, and management of the works herein authorized except as otherwise herein provided.

"SEC. 11. Nothing herein shall be construed as interfering with such rights as the State of Nevada or any other State now has either to the waters within its borders or to adopt such policies and enact such laws as it may deem necessary with respect to the appropriation, control, and use of waters within its borders, except as modified by the Colorado River compact or any other interstate agreement.

"SEC. 12. If any State or States within 6 months after the effective date of this act shall begin a suit or suits in the Supreme Court of the United States to determine the right to the use of water for diversion from the main stream of the Colorado River through pumping plants and necessary works to be constructed pursuant to this act for beneficial consumptive use in Nevada, and to adjudicate claims of right asserted by such State or States or by any other State or States, under the Colorado River compact, the Boulder Canyon Project Act

(45 Stat. 1057), the California Self-Limitation Act (Cal. Stat. 1929, ch. 16), and the Boulder Canyon Project Adjustment Act (54 Stat. 774), consent is hereby given to the joinder of the United States of America as a party in such action or actions. Any State of the Colorado River Basin may intervene or be impleaded in such suit or suits. Any such claims of right affected by the project herein authorized and asserted by any defendant State, impleaded State, or intervening State under said compact and statutes, or by the United States may be adjudicated in such action. In any such suit or suits process directed against the United States shall be served upon the Attorney General of the United States.

"SEC. 13. There are hereby authorized to be appropriated, out of any moneys in the Treasury not otherwise appropriated, such sums as may be necessary to carry out the provisions of this act: *Provided*, That no moneys appropriated under the authority of this act shall be expended for the construction of works authorized by this act which are required solely for the purpose of diverting, transporting, and delivering water from Lake Mead and tributaries, or the main stream of the Colorado River for beneficial consumptive use in Nevada, during the period of 6 months after the enactment of this act and during the pendency of any suit or suits in which the United States shall be joined as a party under and by virtue of the consent granted in section 12 of this act. The pendency of a motion for leave to file a bill of complaint shall be considered pendency of a suit or suits for the purposes of this act.

"SEC. 14. Project No. 5 contains a total of 60,000 acres in the following three areas:

"Areas No. 13, 14, 15: 60,000 acres including bottom and bench land in the vicinity of Davis Dam to be irrigated from the Colorado River.

"SEC. 15. Construction shall not commence, and no contracts therefor shall be entered into, on any portion of the project hereby authorized, if a Federal agency having jurisdiction over the allocation of materials and labor, or either, finds that the materials and labor, or either, necessary for the construction of the project are needed for national defense and by appropriate general regulation, order, or otherwise suspends or prohibits their use for construction of the project hereby authorized, until such suspension or prohibition is rescinded or expires or control over the allocation of such materials or labor is no longer exercised."

Mr. MALONE. Mr. President, the lands involved in these projects would be irrigated from the Colorado River or its tributaries. In Project No. 1, areas 1 to 4 will be irrigated from the Virgin River above Lake Mead, while areas 8, 9, and 10 will receive water from upper Lake Mead. The source of the water for Projects Nos. 2, 3, and 4 will be Lake Mead, while Project No. 5 will obtain its water from the Mojave Lake formed by Davis Dam.

THE ENGINEERING COMMITTEE

NEVADA'S CLAIM FOR WATER

Mr. President, on March 1, 1935, the engineering committee appointed by the Colorado River Conference rendered its report in Salt Lake City, Utah. The report consisted of an analysis of the water commitments on the Colorado River, and included a summary of the E. B. Debler report of December 1934.

The report assumed a total consumptive beneficial use of 900,000 acre-feet in the State of Nevada, based upon their examination and computations at that time.

The members of the engineering committee included myself, then State engineer of Nevada; Edward Hyatt, State engineer of California; and M. G. Hinderlider, State engineer of Colorado. All three of these engineers had represented their respective States in the Colorado River negotiations for 8 or 10 years, and were entirely familiar with all existing reports and investigations, and, in fact, had themselves, over that period of time, made personal investigations and examinations over the entire seven-State area drained by the Colorado River stream system.

Mr. President, I ask unanimous consent to insert in the RECORD as a part of my remarks the report submitted by the engineering committee to the Colorado River Conference in Salt Lake City, Utah, on March 1, 1935, recommending that 900,000 acre-feet of water be allocated to the State of Nevada for beneficial consumptive use out of the Colorado River.

There being no objection, the report was ordered to be printed in the RECORD, as follows:

"PRELIMINARY REPORT OF THE ENGINEERING COMMITTEE APPOINTED BY COLORADO RIVER CONFERENCE IN SALT LAKE CITY, UTAH, MARCH 1, 1935

"A study of the water ultimately available in the lower basin of the Colorado River including all tributaries, based on the report of E. B. Debler, December 1934; analysis of commitments thereon; and an assumed distribution thereof.

"ASSUMPTIONS

"1. Consumptive use of 7,500,000 acre-feet annually in the upper basin as apportioned by the Colorado River compact.

"2. Complete reservoir development in lower basin as set forth in the Debler report.

"3. That Mexico will be allocated 750,000 acre-feet annually.

I. Ultimate usable water supply in acre-feet

1. Net supply for use from main stream below Boulder Dam	8,370,000
2. Net supply for use from Gila River	2,259,000
3. Net supply available for lower basin use above Boulder Dam	240,000
4. Waste crossing International Boundary and usable in Mexico	200,000
Total	11,069,000

NOTE.—Items (1) and (2) are exclusive of waste into Mexico.

II. Present commitments on lower basin supply (including total Gila River, vested rights and contracts)

1. Arizona—total of Gila River	2,259,000
Vested in Colorado River below Boulder Dam	600,000
2. California contracts	5,362,000
3. Present lower basin uses above Boulder Dam in Arizona, Nevada, New Mexico, and Utah	90,000
Total	8,311,000

III. Assumed distribution—additional assumptions

(*a*) Use in Arizona, Nevada, New Mexico, and Utah above Boulder Dam of	240,000
(*b*) Total use by Nevada	900,000
(*c*) Allocation to Mexico	750,000

DISTRIBUTION

1. Arizona:	
(*a*) Gila River	2,259,000
(*b*) Rights below Boulder Dam	600,000
(*c*) Total above Boulder Dam	30,000
(d) Remaining water in stream	[1]988,000
Total	3,877,000
2. California contracts	5,362,000
3. Nevada:	
(*a*) Above Boulder Dam	30,000
(*b*) Balance of proposed contract	870,000
	900,000
4. New Mexico above Boulder Dam	30,000
5. Utah above Boulder Dam	150,000
6. Republic of Mexico	750,000
	11,069,000

Footnote 1 appears on p. 108.

AVAILABLE TO ARIZONA FROM MAIN STREAM OF COLORADO RIVER

Present uses from Colorado River below Boulder Dam	600,000
Assumed ultimate uses above Boulder Dam	30,000
Remaining water below Boulder Dam	988,000
Total	1,618,000

[1] Total available quantity for use in lower basin less allocations contracts, and assumed distributions.

"REMARKS

"1. It is herein understood that water used or to be used above Boulder Dam as above listed, is assumed to come from tributaries of the main stream of the Colorado River. The Nevada contract for water deliveries proposed to the Secretary of the Interior for 900,000 acre-feet, includes both present and proposed uses.

"2. It is assumed that the water used by New Mexico from the Gila River is included in the Gila River commitments.

"3. It is also assumed that Utah will use 150,000 acre-feet of the 240,000 acre-feet of the lower basin water to be used above Boulder Dam, as determined by the Debler report. If as indicated by Utah, that State may require a total of 300,000 acre-feet, the additional amount must be deducted from the net supply listed as available for use below Boulder Dam.

"4. It is not necessarily assumed that all members of the Commission agree in all particulars to the accuracy of the Debler report, but this report is a preliminary analysis of the water supply available for use in the Lower Basin, based on that document.

"EDWARD HYATT.
"M. G. HINDERLIDER.
"GEO. W. MALONE.

"SALT LAKE CITY, UTAH, *March 1, 1935*."

ONLY OFFICIAL REPORT OF ENGINEERS OF THE AREA

Mr. MALONE. Mr. President, the engineering report made for the Colorado River Conference by the three State engineers of California, Colorado, and Nevada was the first and only report by an official engineers' committee of the area.

ESTIMATES POWER AND WATER USE CONSERVATIVE

Mr. President, all reports on the future use of both power and water made over the years of controversy on the Colorado River have been proved conservative through experience over subsequent years. There is good reason to expect that the estimate of 900,000 acre-feet of water for beneficial consumptive use in the State of Nevada will also prove conservative.

WAR THREAT AGGRAVATING WATER SUPPLY

The Korean War and the threat of a third world war are aggravating the short water supply in southern Nevada, especially in the Boulder City, Henderson, and Las Vegas areas, which are the centers of population, and in the Muddy River areas, where vegetables, dairy products, and other food supplies are produced for those cities.

MODERATE PUMP LIFT

The pump lift for the water to be used in connection with the proposed projects is estimated to be from 25 feet to a maximum of 850 feet. Mr. President, no other works are necessary, except pumping plants and the necessary pipe lines, in connection with those plants, to transport the water to the areas mentioned. These areas are shown on an accompanying map which will be available to the committee to which these bills will be referred, namely, the Committee on Interior and Insular Affairs.

ELEVATION AND CLIMATE

The land lies in an area at a maximum of 2,000 feet above sea level, where frost is almost unknown, and where the sun shines 360 days per year. Power transmission lines are already constructed and available for the most part either

actually crossing the proposed irrigation areas or adjacent to them. For purposes of comparison, Mr. President, let me say that the high-water mark of Lake Mead, which is formed by the Hoover Dam, is 1,229 feet above sea level.

[S. 3425, 82d Cong., 2d sess.]

A BILL Authorizing the construction, operation, and maintenance of works diverting water from the main stream of the Colorado River above Davis Dam, together with certain appurtenant pumping plants and canals, and for other purposes

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

NEVADA-COLORADO RIVER PROJECT NUMBERED 6

SECTION 1. That Nevada-Colorado River project numbered 6, for the purposes of providing essential supplies of water for municipal, domestic, and industrial uses, and for the irrigation of public and other lands within the United States, and other beneficial purposes, the Secretary of the Interior, hereinafter referred to as "the Secretary", subject to the terms of the Colorado River compact, is hereby authorized to construct, operate, and maintain (1) a related system of main conduits and canals, including a main canal and pumping plant or plants for diverting and carrying Colorado River water from Lake Mead; and (2) such other canals, canal improvements, laterals, pumping plants, and drainage works as may be required to effectuate the purposes of this Act.

SEC. 2. The Secretary shall have the authority to acquire, by purchase, exchange, condemnation, or otherwise, all lands, rights-of-way, and other property necessary for said purposes: *Provided*, That, anything herein contained to the contrary notwithstanding, the Secretary shall not have the authority to condemn established water rights or the water to the use of which such rights are established, or works used or necessary for the storage and delivery of such water to the use of which rights are established, or the right to substitute or exchange water without the consent of the holders of rights or those entitled to the beneficial use of such waters as may be involved in the proposed exchange.

SEC. 3. The estimated cost of the construction of the said works shall be determined by the Secretary. The Secretary shall also determine (a) the parts of said estimated cost that can be properly allocated to flood control, navigation, fish and wildlife conservation, respectively, and any other purposes served by the project which may hereafter be made nonreimbursable by law, the sums so allocated together with the expenses of operation and maintenance attributed by him to such purposes, to be nonreimbursable, and (b) (1) the part of the estimated cost which can properly be allocated to irrigation and probably be returned to the United States in net revenues from the delivery of water for irrigation purposes; (2) the part of the estimated cost which can properly be allocated to irrigation and probably be returned to the United States by revenues derived from sources other than the delivery of water for irrigation purposes; (3) the part of the estimated cost which can properly be allocated to municipal water supply and probably be returned to the United States; (4) the part of the estimated cost which can properly be allocated for industrial purposes and probably be returned to the United States; and (5) the part of the estimated cost which can properly be allocated to water supply for mining or other miscellaneous purposes and probably be returned to the United States.

Before any construction work is done or contracted for, the Secretary shall first determine that costs allocated to municipal water supply, irrigation, industrial, mining, or other miscellaneous purposes as herein provided will probably be returned to the United States: *Provided*, That the repayment period for costs so allocated shall be such reasonable period of years, but in no event to exceed seventy-five years, as may be determined by the Secretary.

SEC. 4. The Secretary is authorized to supply water for municipal, domestic, irrigation, industrial, and mining purposes in accordance with the provisions of this Act and the Federal reclamation laws.

SEC. 5. Contracts for the delivery of water for irrigation purposes shall provide for the delivery of such water at an identical price per acre-foot at the several points of delivery of water from the main canals and conduits herein authorized, and from such other points of delivery as the Secretary may designate. Such contracts shall be made with the State of Nevada, or with persons, firms, public or private corporations, irrigation, mining, industrial, or other districts, munici-

pal or other political subdivisions thereof, in accordance with the reclamation law. No person shall have or be entitled to have the use for any purpose of any water delivered hereunder except by contract made as herein stated.

SEC. 6. The works provided for by the first section of this Act shall be used: First, for irrigation and domestic uses, and, second, for industrial and mining purposes, and satisfaction of present perfected water rights. The title to all works herein authorized shall remain in the United States until transferred to municipal, irrigation, industrial, or mining districts, as provided or may hereinafter be provided by Federal reclamation law, and the United States shall until otherwise provided by law control, manage, and operate the same: *Provided*, That the Secretary may in his discretion enter into arrangements for the operation or use of a unit or units of said works with the State of Nevada, or any irrigation district, reclamation project, industrial or mining district organized under State law, or other subdivision or agency thereof.

SEC. 7. The rights of the United States in and to the waters of the Colorado River and its tributaries for the use of which the works herein authorized are incidental, convenient, or necessary as well as the rights of those claiming under the United States shall be subject to and controlled by the Colorado River compact.

SEC. 8. The United States in constructing, managing, and operating the works herein authorized, including the appropriation, delivery, and use of water for irrigation, domestic, industrial, mining, or other uses, and all users of water thus delivered and all users and appropriators of water carried by said canals, including all permittees, licensees, and contractees of the United States, or any of its agencies, shall observe and be subject to and controlled, anything to the contrary herein notwithstanding, by the terms of the Colorado River compact and by the laws of the State of Nevada governing water rights wherever the same may be applicable.

SEC. 9. Nothing herein shall be construed as modifying or affecting any of the provisions of the treaty between the United States of America and the United Mexican States signed at Washington, District of Columbia, February 3, 1944, relating to the utilization of the waters of the Colorado River and other rivers as amended and supplemented by the protocol dated November 14, 1944, and the understanding recited in the Senate resolution of April 18, 1945, advising and consenting to ratification thereof.

SEC. 10. This Act shall be deemed a supplement to the reclamation law, which said reclamation law shall govern the construction, operation, and management of the works herein authorized except as otherwise herein provided.

SEC. 11. Nothing herein shall be construed as interfering with such rights as the State of Nevada or any other State now has either to the waters within its borders or to adopt such policies and enact such laws as it may deem necessary with respect to the appropriation, control, and use of waters within its borders, except as modified by the Colorado River compact or any other interstate agreement.

SEC. 12. If any State or States within 6 months after the effective date of this Act shall begin a suit or suits in the Supreme Court of the United States to determine the right to the use of water for diversion from the main stream of the Colorado River through pumping plants and necessary works to be constructed pursuant to this Act for beneficial consumptive use in Nevada, and to adjudicate claims of right asserted by such State or States or by any other State or States, under the Colorado River compact, the Boulder Canyon Project Act (45 Stat. 1057), the California Self-Limitation Act (Cal. Stat. 1929, ch. 16), and the Boulder Canyon Project Adjustment Act (54 Stat. 774), consent is hereby given to the joinder of the United States of America as a party in such action or actions. Any State of the Colorado River Basin may intervene or be impleaded in such suit or suits. Any such claims of right affected by the project herein authorized and asserted by any defendant State, impleaded State, or intervening State under said compact and statutes, or by the United States may be adjudicated in such action. In any such suit or suits process directed against the United States shall be served upon the Attorney General of the United States.

SEC. 13. There are hereby authorized to be appropriated, out of any moneys in the Treasury not otherwise appropriated, such sums as may be necessary to carry out the provisions of this Act: *Provided*, That no moneys appropriated under the authority of this Act shall be expended for the construction of works authorized by this Act which are required solely for the purpose of diverting, transporting, and delivering water from Lake Mead and tributaries or the main stream of the Colorado River for beneficial consumptive use in Nevada, during

the period of six months after the enactment of this Act and during the pendency of any suit or suits in which the United States shall be joined as a party under and by virtue of the consent granted in section 12 of this Act. The pendency of a motion for leave to file a bill of complaint shall be considered pendency of a suit or suits for the purposes of this Act.

SEC. 14. Project numbered 6 contains a total of 42,000 acres of land situated in townships 13, 14, 15, and 16 south, ranges 67, 68, and 69 east, Mount Diablo base and meridian, known as the Mormon Mesa.

SEC. 15. Construction shall not commence, and no contracts therefor shall be entered into, on any portion of the project hereby authorized, if a Federal agency having jurisdiction over the allocation of materials and labor, or either, finds that the materials and labor, or either, necessary for the construction of the project are needed for national defense and by appropriate general regulation, order or otherwise suspends or prohibits their use for construction of the project hereby authorized, until such suspension or prohibition is rescinded or expires or control over the allocation of such materials or labor is no longer exercised.

[S. 3487, 82d Cong., 2d sess.]

A BILL Authorizing the construction, operation, and maintenance of a dam and incidental works in the main stream of the Colorado River at Bridge Canyon

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That for the purpose of controlling floods, improving navigation, and regulating the flow of the Colorado River, and for the generation, use, and sale of electrical energy as a means of making the project herein authorized a self-supporting and financially solvent undertaking, the Secretary of the Interior, hereinafter referred to as the Secretary, subject to the terms of the Colorado River compact, is hereby authorized to construct, operate, and maintain (1) a dam and incidental works in the main stream of the Colorado River at Bridge Canyon, which dam shall be constructed to an elevation of not more than one thousand eight hundred and seventy-seven feet above sea level; (2) complete plants (other than steam plants for the production of electrical energy), transmission lines, and incidental structures suitable for the fullest economic development of electrical energy generated from water at the works constructed hereunder for use in the operation thereof and for sale in accordance with Federal reclamation laws (Act of June 17, 1902, 32 Stat. 388, and Acts amendatory thereof or supplementary thereto); and (3) such appurtenant dams and incidental works necessary for desilting as may be necessary in the opinion of the Secretary for the successful operation of the undertaking herein authorized.

SEC. 2. The Secretary shall have the authority to acquire, by purchase, exchange, condemnation, or otherwise, all lands, rights-of-way, and other property necessary for said purposes: *Provided*, That, anything herein contained to the contrary notwithstanding, the Secretary shall not have the authority to condemn established water rights or the water to the use of which such rights are established.

SEC. 3. The estimated cost of the construction of the said works shall be determined by the Secretary. The Secretary shall also determine (a) the parts of said estimated cost that can be properly allocated to flood control, navigation, fish and wildlife conservation, respectively, and any other purposes served by the project which may hereafter be made nonreimbursable by law, the sums so allocated, together with the expenses of operation and maintenance attributed by him to such purposes, to be nonreimbursable, and (b) the part of the estimated cost which can properly be allocated to power and probably be returned to the United States in net power revenues. Before any construction work is done or contracted for, the Secretary shall first determine that costs allocated to power shall be returned to the United States: *Provided*, That the repayment period for costs so allocated shall be such reasonable period of years, but in no event to exceed seventy-five years, as may be determined by the Secretary.

SEC. 4. In the production, sale, exchange, and distribution of electric energy generated by the works herein authorized, the Secretary shall be governed by the provisions of the Federal reclamation laws, and revenues derived from the sale of such energy shall be credited in accordance with the provisions of the Act of May 9, 1938 (52 Stat. 291).

SEC. 5. The works provided for by the first section of this Act shall be used first, for river regulation, improvement of navigation, and flood control, and

second, for power. The title to all works herein authorized shall forever remain in the United States and the United States shall until otherwise provided by law control, manage, and operate the same.

SEC. 6. Nothing herein shall be construed as modifying or affecting any of the provisions of the treaty between the United States of America and the United Mexican States signed at Washington, District of Columbia, February 3, 1944, relating to the utilization of the waters of the Colorado River and other rivers as amended and supplemented by the protocol dated November 14, 1944, and the understanding recited in the Senate resolution of April 18, 1945, advising and consenting to ratification thereof.

SEC. 7. This Act shall be deemed a supplement to the reclamation law, which said reclamation law shall govern the construction, operation, and management of the works herein authorized except as otherwise herein provided.

SEC. 8. There are hereby authorized to be appropriated, out of any moneys in the Treasury not otherwise appropriated, such sums as may be necessary to carry out the provisions of this Act: *Provided*, That during the existence of the present national emergency, no construction of any part of the project authorized by this Act shall be undertaken, no contract for any such construction shall be entered into, and no money shall be appropriated for the construction during such emergency of any such part of the project: *Provided*, That, for the purposes of this section, the present national emergency shall be deemed to have ended when the exercise of existing Government controls over wages and prices has terminated and when the exercise of mandatory controls over the allocation for domestic use of materials for the construction of such project shall have ended.

SEC. 9. (a) In aid of the construction, operation, and maintenance of the works authorized by this Act, there is hereby granted to the United States, subject to the provisions of this section, (1) all the right, title, and interest of the Indians in and to such tribal and allotted lands, including sites of agency and school buildings and related structures, as may be designated from time to time by the Secretary in order to provide for the construction, operation, or maintenance of said works and any facilities incidental thereto, or for the relocation or reconstruction of highways, railroads, and other properties affected by said works; and (2) such easements, rights-of-way, or other interest in and to tribal and allotted Indian lands as may be designated from time to time by the Secretary in order to provide for the construction, operation, maintenance, relocation, or reconstruction of said works, facilities, and properties: *Provided*, That before designating any tribal lands, or any easements, rights-of-way, or other interests in tribal lands, the Secretary shall make every reasonable effort to negotiate a contract for the purchase of such lands or interests on reasonable terms from the tribe of Indians concerned, and that the Secretary shall proceed with the designation of lands or interests under this section only if he finds that reasonable efforts to negotiate with the tribe of Indians concerned have been made, but have not resulted in, and are not apt to result in, a mutually satisfactory agreement. The Secretary is authorized to provide in any such contract for the payment of compensation in the same forms through which compensation may be made pursuant to a designation under this section, and any tribe of Indians entering into such a contract is authorized to execute the conveyances or other instruments needed for its effectuation, notwithstanding any provision of law or of any tribal constitution or charter to the contrary.

(b) As lands or interests in lands are designated from time to time under this section, the Secretary shall determine the just and equitable compensation to be made therefor. Such compensation may be in money, property, or other assets, including rights to electric energy developed at any of the generating plants herein authorized. In fixing such rights to electric energy, including the rates and other incidents thereof, the Secretary shall not be bound by section 4 of this Act. Any Indian tribe or individual Indian owning lands or interests designated under this section who is dissatisfied with the determination of compensation made by the Secretary shall have a right of action against the United States to recover such additional sums of money, if any, as may be requisite under the Constitution or laws of the United States, or under any treaty or agreement made by the United States, to provide just and equitable compensation for the taking of the lands so designated. Such action may be instituted in the United States district court for the district where the lands or interests are situated or in the Court of Claims, at the election of the plaintiff. The amounts of money determined as compensation hereunder for tribal lands shall be transferred in the Treasury of the United States from funds made available for the purposes

of this Act to the credit of the appropriate tribe pursuant to the provisions of the Act of May 17, 1926 (44 Stat. 560). The amounts due individual allottees or their heirs or devisees shall be paid from funds made available for the purposes of this Act to the superintendent of the appropriate Indian agency, or such other officer as shall be designated by the Secretary, for credit on the books of such agency to the accounts of the individuals concerned.

(c) Funds deposited to the credit of allottees, their heirs or devisees, may be used, in the discretion of the Secretary, for the acquisition of other lands and improvements, or the relocation of existing improvements or the construction of new improvements on the lands so acquired for the individuals whose lands and improvements are acquired under the provisions of this section. Lands so acquired shall be held in the same status as those from which the funds were derived, and shall be nontaxable until otherwise provided by Congress.

(d) Whenever any Indian cemetery lands are required for the purposes of this Act, the Secretary is authorized, in his discretion, in lieu of requiring payment therefor, to establish cemeteries on other lands that he may select and acquire for the purpose, and to remove bodies, markers, and appurtenances to the new sites. All costs incurred in connection with any such relocation shall be paid from moneys appropriated for the purposes of this Act. All right, title, and interest of the Indians in the lands within any cemetery so relocated shall terminate and the grant of title under this section take effect as of the date the Secretary authorizes the relocation. Sites of the relocated cemeteries shall be held in trust by the United States for the appropriate tribe, or family, as the case may be, and shall be nontaxable.

(e) The Secretary is hereby authorized to perform any and all acts and to prescribe such regulations as he may deem appropriate to carry out the provisions of this section.

(f) Nothing in this Act shall be construed as, or have the effect of, subjecting Indian water rights to the laws of any State.

Senator MALONE. Are you familiar with the proposed soil survey and general survey to determine the availability for irrigation of the southern Nevada lands that might be able to irrigate or use the Colorado River water?

Mr. ROBINSON. Only in a general way. I do know that such a proposal, a cooperative proposal with the State engineer and the Soil Conservation Service is under way. I am not familiar with it in detail.

Senator MALONE. Would your United States Geological Survey, which is a department of the Department of the Interior but not part of the Bureau of Reclamation, have an active part in this survey?

Mr. ROBINSON. No; the work of the Geological Survey is confined to obtaining basic data on water supply and do not get into the fields of soils.

Senator MALONE. Do you have any further statement on the water supply in southern Nevada, especially that which would affect the lands within the area that might be included in or are included in the irrigation projects and the cities which would benefit from Colorado River water?

Mr. ROBINSON. Possibly to this extent, our office receives numerous requests from cities and from individuals wanting to know where they can obtain an adequate water supply. These requests, I think last year amounted to some 200. We try to answer those requests to the best of our ability. We do not always have the data at hand for the reason that our operations and our studies have been somewhat limited due to lack of funds.

Senator MALONE. But you generally refer such a request, I suppose, to the State engineer of the State and to the existing reports that have been made available.

Mr. ROBINSON. We always try to answer each request with the best available information at hand, referring them to the State engineer or other agencies if it appears that they have other data or information that we do not.

Senator MALONE. And our State engineer, through this published bulletin, does have all of the information that you have acquired through your survey here and does also include information his office has acquired. I suppose since you cooperated in the survey, it is a mutual undertaking.

Mr. ROBINSON. Yes, that is correct. He has all the information in published form, the ground-water studies in Nevada in cooperative studies, that is to say, each dollar offered for cooperation by the State engineer is matched by the same amount of money by the Federal Government.

Senator MALONE. Yes, I am entirely familiar with that procedure, it was utilized in certain measures when I was State engineer from 1927 to 1935 and of course, has continued to date. The State is limited in its appropriation also and that limits the survey.

Mr. ROBINSON. That limits the amount of money spent on the survey.

Senator MALONE. Thank you Mr. Robinson. We appreciate very much your testimony and if you have any further information to offer, the meeting will be recessed in order to receive such information.

Mr. ROBINSON. I have some published reports on other valleys in southern Nevada, do you care to include them, I would be very glad to submit them. I have copies with me.

Senator MALONE. I think it would be well to submit them to the reporter as further exhibits. Thank you. Is there anyone else in your organization that would like to be heard at this time?

Mr. ROBINSON. Mr. J. W. Odell, of the Geological Survey, has information on the discharge of streams of the Colorado and tributaries to it, who probably should be heard now.

Senator MALONE. Mr. Odell, would you come forward? Will you identify yourself for the record?

Mr. ODELL. My name is J. W. Odell, I am with the Surface Water Branch of the Geological Survey in Salt Lake City.

Senator MALONE. Well, Mr. Odell, if you have information that would be of value to the committee in the furtherance of their approach to this water-supply problem, you may make your report in your own way and submit any written statement that you would care to.

STATEMENT OF J. W. ODELL, SURFACE WATER BRANCH, UNITED STATES GEOLOGICAL SURVEY

Mr. ODELL. My statement will be very short, Senator. Mr. Robinson has covered part of the work of the Geological Survey in the Water Resources Division that operates the network of streamflow stations in the Colorado River Basin, which covers as adequately as feasible with funds available, all data necessary for planning, design or operation of existing projects in the basin. The stations are established at the requests of the various action agencies of the Federal Government and the State engineer's office of the various States. At the present time we operate a fairly adequate system of gaging stations on the

Colorado River, and also a network on the tributaries, which probably doesn't cover quite adequately the needs.

Senator MALONE. You do have a gaging station, however, on the Muddy River and on the Virgin River.

Mr. ODELL. We have several gaging stations on the Virgin River and at the present time we are operating three on the Muddy River and also one on Meadow Valley Wash.

Senator MALONE. And those 3 canyons, the Meadow Valley Wash, the Muddy River, and the Virgin River, are the 3 principal tributaries, at least the only tributaries of live streams out of our State, are they not?

Mr. ODELL. I believe that is correct.

Senator MALONE. Do you have any further statement as to the amounts of water?

Mr. ODELL. I think in regard to that, Senator, I will only say that the information available appears in our published reports which are fairly well up to date. The report for the 1951 water year has been submitted and later information is available on request to the various district offices. We can, at this time, furnish some information to the current water, the 1952 water year, which is just ending.

Senator MALONE. Do you know of any other water supply for the Las Vegas, Whitney, Pittman, Boulder City, Henderson, and industrial areas in southern Nevada except the Colorado River which would include Lake Mead and Davis Dam?

Mr. ODELL. Probably none other that would be economically feasible, Senator, although there is always the possibility of transmountain diversions at some future date, depending upon the needs of the area, and I should also add the availability of other sources. I might add too, that records of the suspended sediment load in streams are collected by the branches of the Geological Survey. This work is being carried on at the present time on the Colorado River and several tributaries in order that the action agencies may have a basis for computing the life of their projects.

Senator MALONE. Of course, when the Bridge Canyon and the Glen Canyon projects are completed, the silt problem in Lake Mead would be pretty well solved, would it not?

Mr. ODELL. There is no question but what the construction of dams upstream would stop the sediment from being deposited in Lake Mead to a certain point.

Senator MALONE. You are familiar with the fact that 5 million acre-feet is included in the 31 million total acre-feet in Hoover for silt alone, so that it is in no way in danger and probably will not be by the time we can obtain silt storage.

Mr. ODELL. As a matter of interest, as to the water supply in this section of the country, I might mention that recently there has been a program of water sampling in the Virgin River Basin that was set up with the idea that they would obtain information on the quality of water at the present time and have basis for comparison with the future, in case of developments on the river areas.

Senator MALONE. Do you have any further statements you would like to make?

Mr. ODELL. I think not Senator, I think that covers it.

Senator MALONE. Thank you very much Mr. Odell for your attendance and for your testimony. Now Mr. Nielsen of the Bureau of

Reclamation, the local office of the Bureau of Reclamation, located at Boulder City. Mr. Nielsen, will you identify yourself for the record?

STATEMENT OF E. G. NIELSEN, REGIONAL DIRECTOR, REGION III, BUREAU OF RECLAMATION

Mr. NIELSEN. I am E. G. Nielsen. I am regional director for the Bureau of Reclamation, region III, headquarters at Boulder City.

Senator MALONE. How long have you been in charge of the district?

Mr. NIELSEN. Since the 1st of September.

Senator MALONE. But you have been located in the area for some considerable time; have you not?

Mr. NIELSEN. Yes; I have been in Boulder City for 7 years.

Senator MALONE. So, you are entirely familiar with the actual operations that have been under way during that period and, of course, you are familiar with the entire setup as it exists. You have heard the testimony by the State engineer and Mr. Robinson of the United States Geological Survey relative to the limited supply of underground water in southern Nevada, with particular reference to that part of the area where Las Vegas, Whitney, Pittman, the Basic industries and Boulder City are located. You have heard the testimony from both of those sources that approximately 30,000 to 35,000 acre-feet of water is the probable, at least the estimated limit of the annual inflow into the valley from the surrounding watershed and that in 1945 or 1946 the use just about equaled the inflow and since that time the waterflow has been continually dropping. Do you know of any other supply available to the southern Nevada areas except the Colorado River and its tributaries, Lake Mead?

Mr. NIELSEN. I would think, Senator, that would be the only practical source for additional water.

Senator MALONE. You are familiar in a general way with the 6 irrigation bills numbered 1297 and 1301 and the additional bill introduced later covering Morman Mesa. These bills were introduced, of course, to cover the obvious areas where it is known irrigable land is located, but without the benefit of a detail soil survey or detail surveys to determine their actual availability; that is to say there will be considerable acreage contained in rough lands and washes that would be unirrigable and also there will be additional areas not covered by the bills. But you are aware of the necessity now of the next step, the necessity of such a survey, soil analysis, and survey to determine the availability of the soil for irrigation.

Mr. NIELSEN. That would be one element in investigating the irrigation potential and an estimate of cost, an investigation of the source of water, the availability of water under existing laws and all of those items will come into the whole picture.

Senator MALONE. Yes; we realize that. Are you familiar with the report that was made by the engineering commission in 1935, that was appointed at Salt Lake City at a meeting, a conference of the Colorado River Basin States to make a report on the probable use of water by the lower basin States, regarding the amount of water that could be used?

Mr. NIELSEN. I want to be sure what that report is, is that the one that you participated in?

Senator MALONE. It is the one in which three State engineers participated in. State engineer of California, Edward Hyatt, who has since retired, Mike Hinderlider, of Colorado and still State engineer, and myself as State engineer of Nevada.

Mr. NIELSEN. We have that report and I have seen it.

Senator MALONE. That was an attempt on the part of the basin States to project the use of water in the lower basin States. You are familiar with the fact that—Arizona, at the present time—there are five States in the lower basin, parts of New Mexico, Utah, and the major portion of Arizona and all of Nevada, included in the watershed and the State of California, are called the lower-basin States. Often it is misunderstood and only the States of Arizona, California, and Nevada are referred to as the lower-basin States. They are the lower-division States. There is a difference between the lower division and the lower basin. When you speak of contracts, you are familiar with the fact that there has never been any agreement between the lower basin States in water.

Mr. NIELSEN. Yes; that is the reason I brought it up.

Senator MALONE. There are certain contracts that each of the States, the States of Arizona, Nevada, and California held with the Secretary of the Interior; you are entirely familiar with those contracts. Those contracts however, would be subject to any subsequent division of water in the lower basin States, would they not?

Mr. NIELSEN. An agreement, or an adjudication, either one I would think.

Senator MALONE. In which case it would probably have to go to the Supreme Court. In that connection you are familiar with the proposed legislation introducted by the California and Nevada Senators. We joined in presenting a bill asking the Supreme Court to adjudicate the use of water in the lower basin. The bill never was reported out of committee. That committee, that Engineering Commission appointed in 1935 and reporting that same year—I am speaking from memory—I do not have a copy of it here, but we previously submitted a copy to be included in the record with the bills I introduced for irrigation of certain areas. Without reference to the other lower-basin States, since the State of Nevada is under consideration now, that committee did recommend that Nevada could use 900 million acre-feet of water, that would include irrigated land, domestic water, water for industrial and mining purposes, stock purposes, all purposes as a matter of fact. This survey would include also the estimated duty of water too; would it not?

Mr. NIELSEN. Yes; that is right.

Senator MALONE. In other words, the duty of water, meaning the number of acre-feet that is necessary annually to irrigate an acre of land.

Mr. NIELSEN. Yes; that would be one of the critical elements, because the water is going to have to be pumped.

Senator MALONE. Also to include estimates of costs of the canals and ditches necessary for the purpose.

Mr. NIELSEN. If you are going to get on the matter of the kind of investigation, I think we should clear up just what you have in mind as a soil-conversation survey by the Soil Conversation Service. The soil survey in the past has been used in identifying soil series and

implying to those soil series the agricultural values and characteristics. We have found that that is not an adequate basis upon which to judge fully the land or irigation potentiality, so we have used the term "land classification," which goes not so much to the academic identification of soils as to its ability to produce profitably under sustained irrigation. I wanted to be sure we were talking about the same thing there.

Senator MALONE. I think it is very good that we go into a little more detail in this discussion because we have George Hardman here who we will hear later. He is of the Soil Conservation Service and the University of Nevada and has over many years done a very fine job in various areas. I have utilized his services in irrigation projects over the years. I agree with you that justification is a more nearly applicable term. The soil surveys imply the character of the soil, and whether it could be improved economically or profitably be utilized under the given conditions. The classification might include the surveys and an accurate estimate of the number of acres. Now do you understand that what some of us have long had in mind, that since I was State engineer of Nevada during 1927 to 1935, and when we were passing the Boulder Dam Project Act in Congress and arranging it so that Nevada would have its proper withdrawal of power and money in lieu of taxes and trying to arrive at a division of water, at least all of us trying to keep from getting hurt if nothing more, and agree to the extent that was necessary to pass the Boulder Canyon Project Act and construct the project, that most of us felt that once the project was constructed, the water and power would be available and there would be something concrete to talk about. Now that has come about and the next step is necessary. You are familiar with all of that procedure from the beginning, at least to the history?

Mr. NIELSEN. That is right.

Senator MALONE. You are also familiar with the fact that Arizona, for example, uses approximately 2,800,000 acre-feet of water out of the Colorado River and its tributaries annually, and that California uses perhaps 4½ to 5 million annually out of the Colorado River, and that the State of Nevada at the present time utilizes somewhere around 70,000 to 75,000 acre-feet of water.

Mr. NIELSEN. I don't think Arizona would concede to the 2,800,000 acre-feet, Senator.

Senator MALONE. I am not talking about what Arizona would concede, I am talking about what the record says. It says that it has 2,800,000 acre-feet of water of the Colorado and its tributaries, and the tributaries include the tributaries to the Colorado River. I am not going to enter into any argument with you on it, but the Colorado River compact makes it very clear and the Supreme Court may have to interpret it sometime, but they do use 2,800,000 acre-feet of water out of the Colorado River and its tributaries. Tributaries meaning all of the tributaries of the Colorado River. I don't think there is any question about the amount at all, it is simply a question as to whether you can cut off the tributary and say that it isn't connected with it at all. I don't want you to enter into it; we will settle that someplace else. Do you have any doubt about the California use?

Mr. NIELSEN. 5,362,000 acre-feet under contract.

Senator MALONE. 5,362,000 acre-feet under contract.

Mr. NIELSEN. Let me say it this way: I believe the use of California in diversions this year, and that is without allowance for return flows and such other credits as California may be entitled to ultimately—I believe that the schedule of diversions is about 4½ million acre-feet.

Senator MALONE. That is a very clear statement, but can't you connect it with what I just said?

Mr. NIELSEN. Yes; you understand, we want to be a neutral agency in this.

Senator MALONE. I want you to be a neutral agency in this, but you will find in every table, including your own reports, the 2,800,000 acre-feet figure, you will find the 4½, you won't find the 75,000, you will find a 300,000 acre-foot figure that Arizona and California agreed that Nevada might have—reluctantly agreed. Now, that is only trying to bring out in this record what the records show each State uitilizes. We do not utilize the 300,000 acre-feet as yet; we utilize about 70,000 to 75,000 acre-feet. Do you judge that about right in the Muddy River, and the amount we take out of the Virgin River, and the amount that is pumped?

Mr. NIELSEN. Without having any information, I would guess that would be a little strong.

Senator MALONE. Then with the 900,000 acre-feet of water that the engineering commission set up that Nevada could use, as a foundation, and with the irrigation bills to use that amount already introduced, we are ready for such a survey as you describe could be made; are we not?

Mr. NIELSEN. I have described only the land-classification activity. I wanted to be straight on that because I am not familiar with the plan that you have developed with the Soil Conservation Service and with the State engineer.

Senator MALONE. I will say, Mr. Nielsen, we have not developed a plan; that is one thing we had you all here for.

Mr. NIELSEN. Let me say then, that we take it to be our job to investigate irrigation potentialities in our region III, and to detail what the studies warrant. That being our responsibility, we would undertake those investigations to the extent that we could get an adqeuate answer from the subjects proposed.

Senator MALONE. And you would cooperate with the State engineer and the soil conservation service of the University of Nevada in such a survey?

Mr. NIELSEN. We are always ready to be cooperative. Now whether you have in mind that we would have some funds and personnel to put into it just as soon as it is ready, I would say we would have to look into that. As we stand, our funds are committed for this fiscal year.

Senator MALONE. And that would be up until June 30 of next year.

Mr. NIELSEN. Yes.

Senator MALONE. How are your funds appropriated for this area, in a lump sum or allocated by Congress?

Mr. NIELSEN. No; they are aprpopriated to us by Congress after the Congress is presented a program of investigations for the Bureau-at-large with the investigations spelled out. So, while there is not a direct authorization goes to each of the individual investigations, there is the commitment on the part of the Bureau that this is the work

we are going to do in the next fiscal year. To change that program, we must present it to Congress.

Senator MALONE. Has that ever been done?

Mr. NIELSEN. Oh, yes.

Senator MALONE. That clears that up. In other words, there is nothing in the way of reallocation of funds except the decision of the Secretary, and the Secretary often does make such a decision.

Mr. NIELSEN. Let's say administratively, for the Secretary isn't often brought into the picture.

Senator MALONE. Who makes the decision to change the place and manner of expenditure?

Mr. NIELSEN. The program can be changed within reasonable limits and within the conscience of the Commissioner, I would say. If we want to change our program, and that goes not only to investigation but to construction, we ask the Commissioner if we may change our program. I might say that he is reluctant to let us change it, but, in some instances, it has been and can be done.

Senator MALONE. That is, the Commissioner of Reclamation?

Mr. NIELSEN. Yes.

Senator MALONE. And who is the Commissioner of Reclamation now?

Mr. NIELSEN. That is Mr. Michael Straus.

Senator MALONE. And who are his assistants?

Mr. NIELSEN. Well, we have one of them here, Mr. Harvey McPhail, Mr. Goodrich Lineweaver is another, and Kenneth Markwell is the third.

Senator MALONE. Goodrich Lineweaver is in such a line of investigation; is he not? In other words, in the irrigation field almost altogether?

Mr. NIELSEN. I am not sure, but I believe Mr. McPhail is in charge of Branch Project Planning; aren't you [speaking to McPhail]?

Senator MALONE. How are they divided?

Mr. NIELSEN. If I remember the lineup, Mr. McPhail has the responsibility for the Divisions of Project Planning and Power Utilization; is that right, Harvey?

Mr. MCPHAIL. Yes; it is.

Mr. NIELSEN. And Lineweaver, operation and maintenance, programs and finance, and Markwell, basic design and construction.

Senator MALONE. It sounds like a very sensible division. Then such a decision could be made within reasonable limits to allocate reasonable amounts of funds to assist in this work even before June 30, 1952.

Mr. NIELSEN. No; I wouldn't want to commit Mr. McPhail.

Senator MALONE. Well, not to commit anybody, but decisions have been made in that category and pretty good ones.

Mr. NIELSEN. It is possible to make them, but it would require that other work now accorded a priority would have to be shifted down the ladder.

Senator MALONE. That isn't the question; the question is, it could be done.

Mr. NIELSEN. It could be done.

Senator MALONE. And has been done?

Mr. NIELSEN. There have been changes in our investigation programs.

Senator MALONE. That is very good. Now you do believe that it is a part of the work of your organization here to enter into such a study when irrigation programs are proposed in cooperation with any other State agency?

Mr. NIELSEN. Yes; that was the statement I made. Now, I do want it to be clear that on investigations proposed by a State municipality, or irrigation organization, we are required by the Appropriation Act to ask that the sponsoring agency pay 50 percent of the cost of those investigations.

Senator MALONE. That would be in this case, who?

Mr. NIELSEN. Well, who will be the sponsor, who will ask us to make those investigations?

Senator MALONE. Well, that will have to be considered, we are trying now to set it up. Now suppose the State engineer requested such a survey and he expended a certain amount of money, would you expend a like amount?

Mr. NIELSEN. To the extent that he expended money in direct furtherance be credited; yes.

Senator MALONE. In other words, if he put men in the field and made surveys and they put in their actual time in the work then you would furnish a like amount of assistance?

Mr. NIELSEN. That is always with the understanding that their work must be a direct furtherance of our work or investigation.

Senator MALONE. Or vice versa.

Mr. NIELSEN. That is right.

Senator MALONE. Now suppose the Soil Conservation Service, George Hardman, of the university, assigned certain men and funds for the job, that would be that part of the 50 percent; would it not?

Mr. NIELSEN. No; if those funds came from the university and were Federal funds, we can't match Federal funds with Federal funds.

Senator MALONE. Well, I think it is necessary to get the record straight, then you could not do any work at all in the matter of soil surveys or any kind of an investigation unless a like amount of work was done by the State of Nevada or some other agency.

Mr. NIELSEN. We couldn't do it at the invitation of the State or any other agency.

Senator MALONE. When could you do it?

Mr. NIELSEN. We could do it in our regular program and course of events.

Senator MALONE. In other words, the Bureau could simply go out and make a survey on its own.

Mr. NIELSEN. Yes.

Senator MALONE. And you do often proceed in that manner?

Mr. NIELSEN. We do conduct investigations entirely with Federal funds; yes.

Senator MALONE. As a matter of fact, probably 90 percent of them are made in that way.

Mr. NIELSEN. No; I wouldn't say 90 percent within our region. Most of ours have been State-sponsored, but we have the job, as you know, of reporting to the Secretary on the irrigation potentialities and the potentialities within the Colorado River basin. We try to proceed with those investigations in an orderly way. When we are called off the regular routine and asked to undertake an investigation

sponsored by someone else, the law automatically requires that they pay 50 percent of the cost.

Senator MALONE. Yes; I can see that and I am glad that we brought out that procedure, because I believe there is a certain amount of work that could be done in that connection, but if you will enter a request from the Commissioner of Reclamation—you are one of his assistants—to furnish such information, and that a certain amount of funds were allocated for the job, that would be entirely within your regular procedure and you would proceed to do that.

Mr. NIELSEN. We would take the direction from the Commissioner, of course.

Senator MALONE. That would be entirely proper if it were done?

Mr. NIELSEN. As far as we are concerned; yes.

Senator MALONE. What—take an estimate of a couple of thousand acres, it might be more and it might be less—what would you say, and this is a tough question because you at this time have a very vague idea of the detail that would be necessary—if you had the funds to proceed with it in a normal manner, how long would it normally take to bundle up such a survey?

Mr. NIELSEN. That is a pretty vague question.

Senator MALONE. I am fully aware that it is vague, but you do know the local areas.

Mr. NIELSEN. I know that there are 6 or 7 or 9 different elements that you propose looking into, all of them require pumping and distribution systems. They all require to be classified in a critical land classification. If we were to program—if we were to be told to do the Nevada work by the Commissioner's office, and to program it along with the continuing investigations of the other States, and the other States, of course, would insist upon their arrangements——

Senator MALONE. You are talking about the other Colorado River Basin States?

Mr. NIELSEN. That is right. I would say that you ought to anticipate it stringing out for 15 years.

Senator MALONE. Well, that would be a regular Government procedure, I guess.

Mr. NIELSEN. Well, but—to go faster—you will have all of our funds and all of our trained personel working in Nevada.

Senator MALONE. I think not. Have you ever made a survey in Arizona in the Central Valley project?

Mr. NIELSEN. Yes.

Senator MALONE. Then maybe you have already discharged some of your responsibilities in the other States.

Mr. NIELSEN. Well, I would think that would be for discussion with the Arizona people when we are to divert our attention entirely away from Arizona.

Senator MALONE. I wouldn't say to divert it entirely away, but to divert some to Nevada. Maybe you could take 1 or 2 of these proposed Nevada projects on, there are 6 of these projects all together. Three of them are very small. Of course, as you know, they would be around the Virgin River, the main tributary.

Mr. NIELSEN. Let me say it this way, it would depend entirely upon the funds and personnel made available to us and I rather think that some of them could be disposed of rather quickly, but I am afraid that

you wouldn't be satisfied with the end result of disposing of them quickly.

Senator MALONE. Well, we might try 1 or 2. Now, you have made a survey of the upper basin States, have you not?

Mr. NIELSEN. That was done by the Salt Lake City office, yes, sir.

Senator MALONE. But you have made such a survey.

Mr. NIELSEN. Not a project survey such as you are talking about here, except that they have developed a plan for the upper Colorado River storage project.

Senator MALONE. Yes; and they have also made certain reconnaissance surveys and soil surveys in the area, have they not?

Mr. NIELSEN. Well, reconnaissance in the same sense as we have in the lower basin because it was all done in the same time.

Senator MALONE. What kind of a reconnaissance did you make down here?

Mr. NIELSEN. Well, just that, a reconnaissance.

Senator MALONE. What would you say was done over these lands out here?

Mr. NIELSEN. Well, first, I am satisfied that Fogerty did them, down at our Washington office, and I think——

Senator MALONE. What was his status then?

Mr. NIELSEN. He was in charge of our land-classification activities in the Colorado River Basin.

Senator MALONE. Where was his station?

Mr. NIELSEN. He was stationed out at Denver at that time.

Senator MALONE. You are sure he got this far away?

Mr. NIELSEN. Well, I am sure he did; yes, sir.

Senator MALONE. Do you have the original notes on his survey, could they be dug up?

Mr. NIELSEN. They could be; yes.

Senator MALONE. I would like very much to see them. I will come down to see you after some of the smoke blows away here, in 3 or 4 weeks.

Mr. NIELSEN. I am satisfied we could get them.

Senator MALONE. He simply reported at that time that the land wasn't suited for irrigation; did he not?

Mr. NIELSEN. Oh, no.

Senator MALONE. That is, it was not suitable to be considered in project form or some other offhand report.

Mr. NIELSEN. No; his job at that time was to classify, by a reconnaissance standard, all the lands which, in his judgment, and rather liberal engineering considerations, could be irrigated, eventually. He wasn't concerned with the ultimate answer of whether the irrigation of those lands was entirely practical, if it looked like by any reasonable stretch of the imagination, it was his job to classify them.

Senator MALONE. But he didn't classify the lands, did he?

Mr. NIELSEN. Yes; he classified the lands. Now, I think you are getting at the possibility that he may have made a windshield survey of the lands. That wasn't done at all. I think I can get you the evidence to show you that it was not a windshield survey.

Senator MALONE. What kind of a survey did he make?

Mr. NIELSEN. He would determine, as the soil types changed, the depth of the soil. At that time we hadn't our water-retention science perfected, but he would look at the texture of the soil and make an

intelligent guess as to the water-retention possibilities. He would look at the general soil profile, not with holes in every 40 acres, but perhaps every time there was a shift in the soil type. There was actual soil borings, there was actual rough levels—taken so as to classify it for slope. There was a definite limitation of those areas which were so steep or so rough as to preclude irrigation.

Senator MALONE. What was his decision?

Mr. NIELSEN. Well, he has not made a decision. The material which we furnished you was of judgment based upon the land classification, the land potentialities, the class, 1, 2, 3, 6, the cost of getting water to those lands and the repayment potentialities. In other words, it is not Fogerty's answer, it is the combined answer as to all of the elements that enter into the irrigation.

Senator MALONE. Do you have such a report with you?

Mr. NIELSEN. We wrote you that letter. I think you have that letter; don't you?

Senator MALONE. I can submit it later. What I am trying to get at now, and this is what I hope you will consider, you have a situation here that you do not have in a lot of these areas. You have 2,500 to 3,000 men working here now, and you have heard the testimony of a probable increase if the power sources are available, and they are, in my judgment. There has been a good deal of question about the Shasta power, there is none in my mind and there never has been, also in the continuation of securing power for the area. There is none in my mind about the feasibility of Bridge Canyon and Glen Canyon Dams. There is no doubt in my mind but what the statement of Harvey McPhail is correct, when he says with the full development of this river there is no secondary power, it is all firm power that would help our allocation considerably. Therefore, looking ahead 10, 15, or 20 years, you could anticipate not 2,500 to 3,000 men working in this area but 4, 5, 6, or 8 or 10 times that number. Now, taking all of those features into consideration would make a difference in the area.

It has never been my idea that this could be a wheat-farming country, with a 600-acre farm or 60-acre farm or any other kind of a large farm and nothing but the ordinary crops, but it has been my idea, and I expressed it in briefs in 1927, 1928, 1929, and 1930, when the Secretary of the Interior was then arguing with us on the possible use of power, as many are arguing with us now on our possible use of water. But these people in the area, when you have 10,000 men working or 15,000 men work in the Henderson area, you will have twice the number of people in the county than there are now. Most of them want a piece of land, even if it is only 200 feet square, a quarter of an acre or an acre or 2 acres or 5 or 10 acres. These men are working, a large part of them you would eventually find out on this, what you might call subsistence-homestead land. Every man has a job, but he also has a little piece of land that he built his house on, maybe he raises some carrots, potatoes, a couple of apple trees, and has a cellar, maybe a dog and a cow, and when a man like that is laid off he goes fishing and doesn't worry about it too much for a few months. If he doesn't have anything but a payroll, his check, then he is worried. That is the thing we have had in mind here for 25 years and we still have it. I personally know, from my experience in irrigation projects for 30 years, that your economics enter into this thing; that it isn't a question of considering this as alfalfa land or

wheatland or farmland. It is a question of considering this area as an adjunct to an industrial area. Then when you build one of these irrigation districts close to one of these towns, it automatically answers the domestic water requirements and they can enter into the expense. Also it is well known now, with our soil-improvement methods, that wherever you have the ground, that has any soil whatever, while it may take a good deal of labor, it is a man's own spare-time labor on his own small tract. With fertilizer and other ingredients, the first thing you know he has a pretty good acre of land. So what I did not like then, and don't like now, is the dismissal of the subject because some other land some place might be better because this didn't look very good to a man by the name of Fogerty, because he made a reconnaissance survey. I think it is time that you pay a little attention to this area, such as you have already with the Central Arizona Valley project. I have listened to testimony by the hour on that. You fellows used to live over there.

Mr. NIELSEN. It wasn't from choice, believe me.

Senator MALONE. I know it may not have been from your choice, but it was by direction of the Bureau of Reclamation. Now, what I am trying to do is get a little direction over this way where these industries are located.

Mr. NIELSEN. Well let me tell you that we have not looked at the economics of the Las Vegas area in terms of what you might call a semiurban development. If you get that kind of development, and if someone is willing to underwrite the cost of such a development, you can get, of course, a good deal more money for water.

Senator MALONE. What do you mean, underwrite the development?

Mr. NIELSEN. Well, we would have to have in the area a contracting agency which would underwrite the cost of the development.

Senator MALONE. You have had that in all these other areas, I suppose, that you have developed. You had it in the Central Valley and you had it in the Grand Coulee?

Mr. NIELSEN. That we developed?

Senator MALONE. Yes. You must remember before you answer that, I am familiar with this area.

Mr. NIELSEN. I think I know what you mean. You mean, have we had at the time we went into the project a going organization. We couldn't have that, of course, on new areas. I didn't say we must have that before we undertake an investigation; we must have an anticipation, a contracting entity, to underwrite the cost of the project.

Senator MALONE. Did you have that at Grand Coulee?

Mr. NIELSEN. The anticipation; yes, sir.

Senator MALONE. Just what agency was that?

Mr. NIELSEN. Several irrigation districts; some were in anticipation, some were in existence, and some were in anticipation.

Senator MALONE. Did they have any assets?

Mr. NIELSEN. Yes; I would say the asset ordinarily or the ability to tax.

Senator MALONE. To tax the potential land that they were going to put under cultivation?

Mr. NIELSEN. That is right.

Senator MALONE. Now let's get down to bedrock. I know something about that project and you didn't have anything. What you

had was a 600-foot lift up there on the desert and potentially good land, and that is all you had. So, your Bureau spent Federal money and put in the irrigation districts and now you are selling the land. You did all construction ahead of time.

Mr. NIELSEN. That is right.

Senator MALONE. That is what I want you to do here. Now let's get down to bedrock and not talk about somebody underwriting the Nevada projects.

Mr. NIELSEN. Well, somebody will eventually have to underwrite it. They will underwrite it at the time that we begin to get a going organization, but we must have it.

Senator MALONE. That is right, but your project is built before then, just as it was up at Grand Coulee. I am not asking you to do this, but I don't want the record to show that you think we have to repay the money before you build the power plant or dig the ditches, because you have not done that on at least several projects with which I am entirely familiar.

Mr. NIELSEN. I don't think I ever mentioned that we were going to get it paid back before we started.

Senator MALONE. But the record would look like it; that is, it would be contracted for before you built it.

Mr. NIELSEN. No; we would have in anticipation an organization which would underwrite the cost of the project.

Senator MALONE. You can stop right there; all you have is an anticipation on all these projects. I was consulting engineer on the Central Valley project in California, and all you had there was an anticipation.

Mr. NIELSEN. You wouldn't exactly endorse that process?

Senator MALONE. I didn't endorse it then, but it made no difference. But what I do want to show in the record and what I do not like, is that you have now changed your policy.

Mr. NIELSEN. Not at all.

Senator MALONE. So what you really need now, it seems to me, if you agree, is a land classification, a soil survey, or whatever you want to call it, as the next step toward the development of the land, with the consideration of the existing and potential conditions. Isn't that about right?

Mr. NIELSEN. For the Las Vegas Valley, I would agree with that.

Senator MALONE. Now then, when you get ready to build it, if these conditions work out, Congress will decide that anyway, and they have in the past, the last 20 years got clear away from any guaranteed payment ahead of construction. In the Boulder Dam construction, now Hoover Dam, we were required in our own legislation, and we did it deliberately, to have contractors underwrite any cost before we sent a shovel into the canyon, and we did that. Now the situation has entirely changed; there has never been another project built like it. We are only asking now, not trying to follow through, that was voluntary information, and I didn't want the record to be closed upon the fact that we would have to underwrite this before anything could be done. We may have to, and maybe we would have to if everyone else does the same.

Mr. NIELSEN. I certainly didn't mean to imply that someone must underwrite it ahead of time.

Senator MALONE. That is what it sounded like.

Mr. NIELSEN. That is not our irrigation-development process.

Senator MALONE. Well it is the irrigation-development process in some cases. My engineering firm formed several irrigation districts, one of them was the Washoe County irrigation district, and we did underwrite the setup before we built the dam. And in the matter of the Nevada Rye Patch Dam, the district voted bonds. Of course, we just thought we had to pay as we went along. But we do agree now, I am sure, that the next step in this consideration, is to make such a survey if we can arrange it. As I understand you now, it is fully within your realm of procedure to make such an investigation if it is ordered and there can be a reallocation of funds, and there could be money appropriated for it in the next fiscal year, if Congress so desired, and that you can, and this is information for the record, you can cooperate with State agencies if they put up 50 percent or match your work.

Mr. NIELSEN. Yes, I was going to broaden that. We always intended that our operations be cooperative, but in terms of spending funds at the invitation or under the sponsorship of a State agency, then that agency must furnish 50 percent.

Senator MALONE. Well, what I had in mind more than anything else, was that there would be a general cooperation and that could be brought about through individuals, say even not officially, the State engineer could cooperate with you, and the Soil Conservation Service would cooperate with you and there would be no arrangement of the 50–50 expense at all. They would simply cooperate with your survey.

Mr. NIELSEN. If we were allocated funds separate from that 50 percent requirement we would have to go ahead, yes.

Senator MALONE. It is the next step in this procedure, in this valley, you agree with that?

Mr. NIELSEN. I would think with the Las Vegas Valley, yes.

Senator MALONE. Do you have any further information that you would like to offer?

Mr. NIELSEN. No, I will be interested in finding out what Mr. Hardman's idea is of this investigation; I haven't heard yet.

Senator MALONE. Mr. Hardman generally has very definite ideas, but I know he will be cooperative. I thank you very much, Mr. Nielsen, and you can be assured of the cooperation 100 percent as far as I can arrange it. I would like to ask Mr. George Hardman if it would be an inconvenience to him to stay over until Monday. We can't use this hall this afternoon.

Mr. GEORGE HARDMAN. I suppose it could be possible. I have my reservations back on the train, but I suppose I could stay over.

Senator MALONE. If you could, George, because they are going to use this theater for a show here this afternoon, and Mr. Harvey McPhail is leaving definitely tonight, and I would like to hear him for a few minutes before recessing until Monday morning, 9:30. Mr. McPhail would you come forward again?

Harvey, you have heard most of the testimony relative to power use in the area. Some of the users, contractors, were not able to come today but will Monday, but you did hear Mr. Gibson and Mr. Newell testify to their use of power, and you did hear Mr. Rollin Smith yesterday. It seems that they all have plans for expansions that are far-reaching providing power can be made available. Do you have any further com-

ment to make on the power supply or the urgency or the potential development on the Colorado River?

STATEMENT OF HARVEY F. McPHAIL, ASSISTANT COMMISSIONER, UNITED STATES BUREAU OF RECLAMATION—Resumed

Mr. McPHAIL. Senator, I have listened to all of the testimony that has been presented and there appears to be no question about the desirability and necessity of greatly increased power in this area if its development as an industrial center is to proceed. I still feel that the long pull in connection with this development lies within the hydro resources in the Colorado River.

Senator MALONE. And you do believe, as I understood you to testify, that with this development of the river up to and including Glen Canyon, that includes the existing developments down to and including Parker, that there would be about 21 or 22 billion kilowatt-hours of firm power developed eventually.

Mr. McPHAIL. That is approximately correct, in my opinion.

Senator MALONE. Fifteen billion of which would be around the Bridge and Glen Canyon area.

Mr. McPHAIL. Fifteen billion is potential in the stretch of the river from Glen Canyon down through Bridge Canyon.

Senator MALONE. And it does require those developments in order to firm the power that is now called secondary?

Mr. McPHAIL. Well, each development that is made on the river will serve to further regulate the flow in the river so that more and more of the energy available becomes firm energy.

Senator MALONE. In other words, the water is held over in the reservoirs, like Glen Canyon, with a 26 million acre-foot reservoir, and Boulder at Lake Mead being a 31.5 million acre-foot reservoir, and then with the auxiliary storage in the smaller reservoirs, makes it possible to hold it over and make firm power out of all of it.

Mr. McPHAIL. That is correct; the developments that are more the run-of-the-river class will be Bridge Canyon because of the small storage capacity, can generate to the full extent when the runoff is heavy, and the storage reservoirs will serve to reregulate that water so as to maintain the production during the period of year when the runoff is lower.

Senator MALONE. That would increase the firm power to the present contractors. In other words, Southern California Edison has a certain percentage of firm power, bureau of power and light has a certain percentage, the State of Nevada and the State of Arizona have a certain percentage, and that percentage of firm power then would be more horsepower or kilowatts under that designation than before, as these developments proceed.

Mr. McPHAIL. I wouldn't attempt here, Senator, to say what the allocation of the development would be; it would certainly increase the available firm power for this general southwest area.

Senator MALONE. In other words, a percent of the power developed would include more firm power but not as much secondary, and make it much easier and more satisfactory to make power contracts in the area.

Mr. McPHAIL. It is a little difficult to make power contracts when you don't have power.

Senator MALONE. Now, in our meeting at Carson City several months ago at the Governor's office, where we arrived at the general conditions that would govern the contract for Shasta Dam power with the State of Nevada, the Colorado River Commission representing the State of Nevada, we arrived at the general principals that govern such a contract. I think you said then that there would be other developments on the project, such as Folsom coming in in 1954, and at least 1 other on the American River, 1 or 2 or 3 on the Feather and several developments on the Trinity Rivers, and the same policy as to the allocation of power without any indication as to who might get it but the same policy of the allocation of the power under the Bureau of Reclamation Act would prevail.

Mr. MCPHAIL. Assuming that future developments are authorized in California under reclamation laws, then the provisions of that law would govern it.

Senator MALONE. Just as they do in the Shasta and just as they did, although they were special provisions, in the Boulder Dam Project Act, the same policy prevailed there, did it not?

Mr. MCPHAIL. Well, the Boulder Canyon Act was somewhat different than the reclamation law, it was a special act.

Senator MALONE. But there was a customer preference provision.

Mr. MCPHAIL. I believe so, I don't recall just what the wording of that was.

Senator MALONE. I can assure you that there was considerable discussion about that at the time.

Senator MALONE. Do you have any information that you think would be interesting to the committee?

STATEMENT OF J. G. WILL, SECRETARY AND GENERAL COUNSEL, UPPER COLORADO RIVER COMMISSION

Mr. WILL. Well, Senator, I would like to make this suggestion, while I was not present at these hearings yesterday, I did read the newspaper accounts of them and I noted references this morning on a number of occasions, to the need for power to be developed at the Glen Canyon Dam, and that all seems to me, if I may be so bold as to suggest it, that the States of the Colorado River Basin would get together and support our efforts to obtain the authorization of the Glen Canyon Dam and Reservoir as a part of the Colorado River storage project.

Senator MALONE. I am entirely in sympathy with that point of view and in the further allocation of power from any of these projects the State should be consulted and for this hearing, you were notified mostly because of your known interest.

Mr. WILL. We deeply appreciate your telegram, Senator.

Senator MALONE. It was sent for the purpose so that you would know that you were not being overlooked, although in this particular hearing it is more on a national-defense basis. It would not be necessary to have the hearing until Congress settled down in March or April had it not been for the national-defense picture. If you had heard the testimony—I fear you did not—the urgency for more power for titanium and for products that enter into the manufacture of titanium, like chlorine and other materials, is great.

Mr. WILL. It seems to me, Senator, that these hearings have accomplished the objective of dramatizing those needs.

Senator MALONE. I hope so. Generally congressional hearings are rather dreaded affairs because we have to confine ourselves to actual statements and facts as much as possible, and people think each one is just another congressional hearing, which it probably is, but if we can lay before the Public Works Committee, and to discuss with any committee to which legislation may be referred, in January, the extreme national-defense need for additional power and the sources of such power, I think we can have a rather exhausting discussion as to all the sources of power. Then they can call a regular hearing based upon this subcommittee start. Now your Upper Basin States, of course, as you know, you could go to any hearing that has to do with Colorado River Basin affairs and you would do so if you thought your interests were involved, and I think they are regardless of where the developments are. I think it is to our interest to listen to any testimony of any project that you propose up above, because it does affect us down here. And, personally, I can only speak for one Senator, but, I am for the development of the Colorado River, in the most comprehensive way, and the only way we can get at that is the way we are doing it now. I am very gratified that you are here, Mr. Will. Do you have anything further that you would like to offer now or supplemental statement?

Mr. WILL. I would like to have your permission to file a supplemental statement.

(The statement referred to is as follows:)

DEPARTMENT OF THE INTERIOR,
BUREAU OF RECLAMATION,
Boulder City, Nev., October 27, 1952.

Hon. GEORGE W. MALONE,
United States Senator, Reno, Nev.

MY DEAR SENATOR MALONE: Mr. John Geoffrey Will, secretary and general counsel for the Upper Colorado River Commission, appeared at your subcommittee hearings in Henderson on October 11 and was given permission to file a statement on behalf of his agency. Lacking information as to the reporter to whom that satement should be forwarded, Mr. Will has forwarded his statement to me with the request that I put it in the appropriate hands.

I am in turn forwarding the statement to you by means of this letter.

Sincerely yours,

E. G. NIELSEN,
Regional Director.

STATEMENT BY JOHN GEOFFREY WILL, SECRETARY AND GENERAL COUNSEL, UPPER COLORADO RIVER COMMISSION

I deeply appreciate the opportunity afforded me by Senator Malone to file this statement in addition to the brief statement that I had an opportunity to make in person.

The Upper Colorado River Commission is an administrative body. Its membership consists of 1 commissioner from each of the States of Colorado, New Mexico, Utah, and Wyoming, and 1 commissioner representing the United States of America. Because of its comparatively slight land area in the upper basin, Arizona is not represented on the commission and does not participate in the expenses of its administration. Each commissioner from a State holds office as such under and by virtue of the laws of the State which he represents. He is, in other words, accountable to his State for actions taken by the commission.

The objectives of the commission include: (*a*) The provision of fact-finding facilities such that findings made by the commission with respect, for instance, to the extent of consumptive use in the upper basin shall be deemed authoritative; (*b*) securing the expeditious agricultural and industrial development of the upper basin; and (*c*) achieving a form of administration, operation, and maintenance of works and programs for the development, conservation, and utilization of water resources in and for the upper basin designed to afford

completeness of approach, unity of administration, the utmost practicable sensitivity to the needs and desires of the people affected, and full protection of the interests of the Federal and State Governments.

Progress toward the accomplishment of the first of these objectives is continuous. With respect to the second of these objectives, the commission has worked closely with Federal and State agencies to the end that the plan finally produced should be as sound and as practicable as humans can make it and should, therefore, find ready acceptance in the executive and legislative branches of Government as well as by the people affected. It is our view that such development should be authorized promptly. The development of the upper Colorado River Basin has too long lagged behind that of other areas of the West. The plans for its development are sound from the engineering and financial point of view. Development, to the fullest extent permissible, within the limits of consumptive use apportioned to the upper basin by the Colorado River compact, will redound also to the benefit of the lower basin and of the Nation as a whole. We shall seek authorization of the upper Colorado River storage project and participating projects at the earliest practicable date. We shall seek their authorization as measures that will contribute mightily to America's war potential as well as to her peacetime prosperity.

The Upper Colorado River Commission does not conceive that development of the water resources of any river basin is confined to the job of constructing and operating dams and power plants, conduits, canals, transmission lines, and other physical works, important as they may be. The development, conservation and utilization of the water resources of the Upper Colorado River Basin is conceived by the commission to consist in the application of all effective means available through human knowledge and experience to the problems of finding and preserving sources of water, preventing waste of water, of preventing damage from water, and of putting water to use for the benefit of the people of the area and of the country as a whole. In other words, the commission believes that the impact of all known means and of means hereafter discovered for the development, conservation, and utilization of the upper basin's water resources should be brought to bear upon the problem. Obviously, this signifies areas of activity that fall today beyond the province of any one agency of the Federal Government and, for that matter, of State government as well. It involves, in fact, activities carried on today by many agencies of government both State and Federal, and certain activities that ought to be carried on with greater effectiveness than they are. We would invite attention to the needs for soil conservation, reseeding and reforestation programs as well as to the need for the provision of storage. We believe, in fact, that there should be increased emphasis on the control of silt at its source, that is to say, on programs for the reduction of erosion. We would invite attention to the need for consideration of means to avoid the pollution of streams as well as to the need for the consideration of means of putting water to domestic, agricultural, and industrial use; and we would invite attention to the consideration of means, not only of preserving but of enlarging, to the extent practicable in the light of other human needs, the recreational and the inspirational aspects of water-resources development. Fish and wildlife resources are an inseparable part of water resources. While, as I have ventured to say on more than one occasion, we object strenuously to the notion that the West should be preserved as a permanent museum of natural history, we believe that the protection and improvement of national park and monument resources are, in many cases, an inseparable part of water-resources development programs. They must, to the fullest practicable extent, be developed, conserved, and utilized for the enjoyment and inspiration of all the people and not, as Mr. DeVoto and some of his friends would apparently prefer, maintained in all their grandiose inaccessibility, for the benefit of a wealthy few. The fulfillment of Federal obligations to Indian tribes is, necessarily in certain areas of the West, inseparable from water-resource development, conservation, and utilization problems.

After the proclamation of consent by the United States of America to the Colorado River compact of 1922, there followed a period of rapid progress in the development of the water resources of the Colorado River Basin. Certain barriers to that progress had been overcome by the enactment, for instance, of the California Self-limitation Act, by the priority agreement entered into among California's important water users and prospective water users and by other transactions within other lower basin States. We have seen in the Lower Colorado River Basin, and we are happy to see there, a series of vast developments and arrangements for taking the fullest possible advantage, both within and

without the Colorado River Basin, of the consumptive use apportioned to the lower basin by the Colorado River compact of 1922. Hoover Dam, Parker Dam, and Davis Dam, and their incidental features in the Lower Colorado River Basin are names to conjure with. As against these works, development in the Upper Colorado River Basin has been comparatively negligible. Ex-President Hoover, who served and greatly distinguished himself as the representative of the United States in the negotiation of the 1922 compact, felt that the development and utilization of the water resources of the upper basin would be slower. He turned out to be a prophet. That development has indeed been slow. Two principal obstacles to such development have been overcome. A third and final barrier will, I trust, be overcome in the near future.

The first obstacle to further significant development and utilization of the water resources available to the Upper Colorado River Basin States consisted in the lack of apportionment among them of the consumptive use that was apportioned to them as a group by the 1922 compact. The second of these obstacles lay in the failure of those same States to determine their respective duties, and ways and mean of fulfilling the same, with respect to the obligation which they had theretofore jointly undertaken not to deplete the flow of the river at Lee Ferry below 75 million acre-feet in any period of 10 consecutive years. Both of these obstacles have been overcome through the successful negotiation of the Upper Colorado River Basin compact, whereby the States concerned have agreed: First, upon the subject of apportionment; and, second, upon ways and means of fulfilling their duties under the 1922 compact. The third obstacle to their development and utilization of the water resources of the Upper Colorado River Basin, consists in the lack of physical means therefor. The Upper Colorado River storage project and participating projects constitute their attempt to overcome in large part the third and final barrier to which I have referred. And when I say "their attempt" I use that expression advisedly. For, although the plans themselves were evolved by engineers and others in the Bureau of Reclamation of the Interior Department, as well as by employees and officials of other agencies and departments in the executive branch of the Federal Government, they are not only the end result of some 50 years of painstaking investigations on the part of the Federal Government. They are, in truth and in fact, the end result also of many years of consultations with officials and citizens of the affected States and, more recently, with the Upper Colorado River Basin Compact Commission and with the Upper Colorado River Commission. It would, therefore, be inaccurate to refer to the Colorado River storage project and participating projects as a purely Federal plan. It is a plan too that has, in the main, been adopted by the upper basin States.

You may well ask: What purpose or purposes will be served by the construction of these very sizable works? Well, one of the principal purposes that the main-stem reservoirs will serve is comprehended within the term "holdover storage" that is so frequently used in connection with this project. I have referred heretofore to article III (d) of the Colorado River compact of 1922, which requires that the States of the upper division, that is to say: Colorado, New Mexico, Utah, and Wyoming, shall not deplete the flow of the river at Lee Ferry below an aggregate of 75,000,000 acre-feet for any period of 10 consecutive years. We have, for all practical purposes, arrived at that point in the upper Colorado River Basin where, in the light of long-term records of flows of the river, we may not undertake long-range plans for further highly significant consumptive-use projects and feel confident, at the same time, of our ability to live up to the letter and spirit of that obligation without the construction of large reservoirs that can be used to hold quantities of water, received in years of plentiful flow, to be released to the lower basin in years of low flow. Here, you will note, one of the prime purposes for which the upper-basin States seek the authorization of the Colorado River storage project is to create a system of reservoirs which will assure that the obligations solemnly entered into in the 1922 compact will be fulfilled, while, at the same time, the consumptive use to which the upper-basin States are entitled may proceed without interruption that otherwise might be caused by highly erratic flows. But these holdover storage reservoirs can serve additional purposes as well. For instance, while no part of their cost is proposed at this time to be allocated to that purpose, they can be of tremendous significance in assisting the United States of America to fulfill certain treaty obligations to Mexico. They can and will serve to control floods. Through their collection of silt and sediment, they will greatly lengthen the life of Lake Mead, the reservoir in back of Hoover Dam. Their vast reaches will create recreational and tourist attractions that will surpass anything so

far known in our part of the West and that will be second to none in the world. Finally, the release of water from these reservoirs will afford opportunities for making hydroelectric power on an impressive scale. The five main-stem reservoirs listed for initial development will have an initial-installed capacity of 1,102,000 kilowatts. To get some idea of what this means it is sufficient to say that the powerplants at these five dams alone (not counting prospective power installations in the Gunnison River Basin) will have an installed capacity just slightly less than the present installed capacity at Grand Coulee Dam, slightly exceeding the present installed capacity of Hoover Dam, and almost 20 times the present installed capacity of the Colorado-Big Thompson project.

The hydroelectric power which will be generated at these dams will find a ready market. Net revenues derived from the sale of the power will be used, not only to return to the United States its capital investment in the powerplants themselves, it will be used also to help pay out those costs of participating irrigation projects which are beyond the repayment ability of the water users themselves. And then, when such pay-out has been achieved, such net revenues will, in accordance with provisions of existing law, flow into the Treasury of the United States.

Senator MALONE. You have the permission of the chairman and I might say that that was the reason we were going to recess the hearing and not adjourn it, and I might say not close it before a couple or 3 weeks before January 3, at which time Congress will convene. You may give it to the secretary who is going to take care of the transcript and if it is voluminous we can make it in the form of an exhibit; if it is just a few pages, we will make it a part of the record. Is there anyone else who is in a jam here? If not, we will recess until 9:30 Monday morning, and there is a possibility that we might transfer the hearing to Las Vegas. We had it here mostly to hear the people in the area, and to get away from interfering with any other meeting they might have in Las Vegas. The Governor had a hearing on another matter there but it also had to do with availability of power for the citizens here. Mr. Alfred Merritt Smith, who is my administrative assistant is at the Elwell Hotel, and if you check with him sometime tomorrow, if there is any change in place Mr. Smith will know by tomorrow afternoon. I will try, also, to have some notice in the paper, Monday morning, if we are going to continue here or in Las Vegas. Thank you all for coming and for the ones who were not heard, I am sorry, we will try to close it up Monday.

VOICE. Governor, some of us may have to leave. Could you give us some idea as to the proposed program you will follow Monday?

Senator MALONE. We will complete if possible the soil-conservation survey and any surveys that are made in connection with the irrigation, domestic water, and industrial water program, and perhaps there will be 2 or 3 additional appearances on the availability of power in this area and the need for additional power by existing industries here. I think that is what will be involved. Thank you all.

FLOOD CONTROL, POWER, AND WATER RESOURCE DEVELOPMENT, COLORADO AND MUDDY RIVERS, LAS VEGAS WASH, NEV.

MONDAY, OCTOBER 13, 1952

UNITED STATES SENATE,
SUBCOMMITTEE ON FLOOD CONTROL, RIVERS AND HARBORS
OF THE COMMITTEE ON PUBLIC WORKS,
Henderson, Nev.

The committee met, pursuant to call, at 10 a. m. in the Court House, Las Vegas, Nev., Senator George W. Malone presiding.

Senator MALONE. The meeting will come to order. This is the subcommittee of the Public Works Committee of the United States Senate. The meeting has been called starting on the 10th, last Friday, to determine the amount of power that is necessary to continue the national defense production in this area for the present investment, and the amount of power necessary in the future before investments can be made by the operating companies, the industrial companies in the area, including Titanium Metals Corp. of America, Stauffer Chemical Co. of Nevada, and others that are producing highly essential commodities, such as titanium, chlorine, and defense metals, and chemicals. It has already been shown in the hearing that additional power is necessary now, a considerable amount of additional power is needed to make increased production from the plants that are already operating in the area. It is shown that the present use is approximately 484 million kilowatt-hours per year, and that by 1953 a demand of 622 million kilowatt-hours will be necessary, and by 1960 a demand of 1,700,000,000 will be necessary. These are in billion kilowatt-hours; a correction. In other words by 1960, the area will require roughly twice the amount of power that is available from the Hoover Dam and Davis Dam. Therefore new sources of power must be made available to justify the necessary construction and the additional power must be available before the additional construction can be made. This testimony has been offered by the companies in the area, including Fred D. Gibson, manager of the Western Electrochemical Co. and Art Newell, works manager of Stauffer Chemical Co., both at Henderson, and by A. J. Shaver, chief engineer of the Colorado River Commission.

The sources of power that have been suggested are the Central Valley project of California, where only the last few weeks a contract for 33,000 kilowatts, 30,000 for southern Nevada, meaning the Henderson area, would be available for that under that firm contract, which has set the precedent for even more power from the Shasta Dam, if it can be shown that it is needed for national defense—and it has been

shown during this hearing—and then through Folsom Dam which will be completed in 1954, with about 170,000 kilowatts on the American River and within the Central Valley project and perhaps 50 to 60 thousand or even more kilowatts can be secured there when it is ready, providing it is shown it is a national defense need. We can get our share under the customers-preference clause whether it is national defense or not. Now then there are further dams within the Central Valley project contemplated on the Feather River and the Trinity River; it is a 25-year program as everyone knew who was connected with the project and I was consulting engineer on that project in 1935. There is that definite source of power during the next few months and during the next 4 or 5 or 7 years. The next source of power is the Bridge Canyon and the Glen Canyon sites which have been already described in the record. Bridge Canyon, about 700,000 kilowatts, Glen Canyon, approximately 800,000 kilowatts. Harvey McPhail, who is Assistant Bureau of Reclamation Commissioner testified on Friday and Saturday of last week, that with the full development of the Colorado River from Glen Canyon to Parker, inclusive, practically every kilowatt can be made firm power; therefore there will be an increased amount of power on the river even in the Hoover Dam project. Therefore the 36 percent of the firm power available to Arizona and Nevada on a withdrawal privilege, which has already been fully described elsewhere in the hearing, would amount to more power than it does now. In addition to these sources, Mr. A. J. Shaver, engineer for the Colorado River Commission, has testified that steam power through coal from Utah and steam power through the use of natural gas which we are going to receive in a short time, from the pipeline from Texas to northern California, our diversion pipeline to be from Needles, will bring in a certain amount of natural gas that might be used for steam-power purposes.

Other temporary sources which will be necessary might be from Arizona, part of their share of the Boulder and Davis power, and also power from southern California that has been allocated for pumping water in the Metropolitan Aqueduct and for southern California cities for other purposes. That power is of a temporary nature; in other words, it is subject to withdrawal by them on notice. It would only be of a temporary nature and we could only use it until they need it; it is their power. So, the firm sources of power that I have mentioned starting from Shasta Dam project and going on to the Feather and Trinity Rivers over the years and the Glen Canyon and the Bridge Canyon which are the only two remaining sites of any consequence on the Colorado available to the lower basin. Glen Canyon is not in the lower basin; it is just above and located actually in the lower edge of the upper basin States. Now another source of power, in the opinion of this committee, and of course the chairman is only one member of the Public Works Committee, another important source of power that will prove in the years ahead to be very important and now is in the experimental stage is atomic power. The Atomic Energy Commission is working on nuclear energy for commercial power, converted to commercial power. Everyone understands that atom bombs are what the AEC has concentrated its attention on, and properly so. Everyone is familiar with the explosions in Japan at

the end of World War II. Everyone is naturally familiar with the fact that a large area in Nevada has been set aside for such experiments and has been used continuously for several years since the war. I have been present for several of these explosions and have been cleared for all information from the Atomic Energy Commission for some time and am probably the only man in Nevada that is so cleared. I have been working with the Commission, knowing that they want to divert part of their attention to commercial power, and instead of explosions in bomb. to simply slow down this energy from fissionable uranium energy and use it to produce commercial power. Knowing something of atomic reactor technology and having information that they were approaching the time when they want to put in a larger pilot plant, you can call it anything you want to but probably from their standpoint it would be pilot plant of anywhere from 10, 15, 25, to 30,000 kilowatts capacity to produce commercial power for the first time in history. There are several small experimental plants were power has been produced, and AEC know they can do it. It is a question now on a commercial scale, and that is the way we got into the picture and for various economic reasons suggested that it be constructed at Eureka, Nev. The Atomic Energy Commission has recently taken up the matter with the Bureau of Reclamation and Harvey McPhail again has been the spearhead, and they have now arranged with the Bureau of Reclamation, through Mr. McPhail, to make a special power survey in central Nevada to determine the available market which would have something to do with the size of the plant constructed, providing it is decided to be constructed at Eureka. This decision has not been made, but it has been my understanding from the beginning that we are under consideration, and Dr. Hafstad, Director of Reactor Development, has already made a trip to Nevada and personally examined the area. He is here today and he will be our first witness. I did intend to hear Mr. Hardman first, from the Soil Conservation Service, but since he is here, and since Mr. Nielson is here from the Bureau of Reclamation, I think we will call Dr. Hafstad first.

I want to say that this power while yet in the experimental stage, might prove tremendously important in the years ahead. We are not talking now of tomorrow, for Shasta Dam power can be gotten here in 6 hours, as Harvey McPhail testified, if we need it bad enough for national defense. There isn't any question about that. That was his testimony up in Carson City when we first met. It wasn't when we first met but at the last meeting when we outlined the conditions and policies and principles under which Nevada would contract with the Bureau of Reclamation for Shasta Dam power, which is already now done, and the contract is signed. I hope it is in the governor's safe and locked up. I anticipated that several months ago. Now this prospective new power, commercial power from atomic energy, I am going to let Dr. Hafstad tell the story about that. One pound of this U–235 uranium isotope that is produced from raw uranium metal in the gaseous diffusion plant at Oak Ridge, Tenn., contains vast energy. I have examined that plant; I have been through it. It is a very highly classified process, but when they arrive at this fuel, 1 pound of it has the energy of 2,600,000 pounds of coal. In my humble

opinion, it will affect your lives much in the years ahead through its various ramifications, as the cost of this prospective commercial power comes down, and it will. They are learning more every day. There isn't any question but what they will cheapen the gaseous plant method of separating this metal into the components required for bombs and for power. Any reduction in cost will affect the commercial aspect. In my humble opinion, it may affect your lives more than the 4 or 5 great inventions made in the last 2,000 years that have affected the course of history. Like the wheel, the steam engine, electricity, all of these changed with history, and this will change history also in my opinion. It is only a matter of time and the work of highly technical men like Dr. Hafstad. He is the commercial power expert of the Atomic Energy Commission and is working his heart out on this stuff, and is not getting the cooperation, I might say, that he ought to have, but he will get it when Congress convenes again, if I have anything to do with it. Gordon Dean, Director of the Bureau of Mines is the AEC Chairman. They have formerly devoted their entire existence to warwork. Now they have a section of their Commission devoted to peacetime purposes and soon they will build this pilot plant. I hope the economics are running with us on it, and that it will be built in Eureka—I will let Dr. Hafstad tell the story. The minute they show that can be done, the wartime Commission will become a peacetime Commission, and then all of this money will not have been wasted.

In my opinion, this is the most important hearing that has been held by any major committee of Congress since Hoover Dam was completed. Your industries are here. You already have realized the industrial center that I used to write briefs about in 1927–28–29 and 30, before we received the contracts for the withdrawal of power. Once you establish an industrial center they feed off each other. That is what they are doing down here right now. One of them produces something and the other uses it. The most important metal today is titanium. I have letters here that are highly confidential, I cannot read them. They show the Secretary of Air has said virtually that they must have the power to replace their military planes through the use of titantium in the vital parts. It is twice as strong per pound as aluminum. It is stronger than stainless steel per pound. It will not corrode in the air or under sea water and has other classified properties which are essential in replacing fighter planes and bomber planes at the earliest opportunity that these kids of ours are riding in and out of Korea and will be riding in someplace else just as soon as you send them. First the "police" action, and I will not discuss my opinion of the police action, because it is not important in this connection. As long as we have them we have to win them, and you cannot win them unless you control the air. We do not at the moment control the air, according to General Vandenberg and others. Why we lost it I will not discuss here either, that is for another time and place. Dr. Hafstad, will you please come forward and state your name and your connection with the Atomic Energy Commission for the record?

STATEMENT OF DR. LAWRENCE R. HAFSTAD, DIRECTOR OF REACTOR DEVELOPMENT, ATOMIC ENERGY COMMISSION, HENDERSON, NEV.

Dr. HAFSTAD. My name is Lawrence R. Hafstad; my title is Director of Reactor Development for the Atomic Energy Commission. In that position I am responsible for all new reactor development work, including that on mobile reactors for submarines, aircraft, and new versions of production reactors, as well as reactors for producing power.

Senator MALONE. Then you are responsible for cooperating with Captain Rickover in the construction for the reactor necessary for the new submarine?

Dr. HAFSTAD. Captain Rickover reports to me on all of the reactor work. This work is done by Captain Rickover under my direction. The submarine work, the ship work is done by the——

Senator MALONE. Dr. Hafstad, you have been holding out some lately. I have conferred with Captain Rickover, and not officially, but unofficially, have watched the development of this new submarine which will travel twice as fast as any submarine under water for an indefinite length of time, which we think is the development of the ages almost as far as the submarine warfare or any ocean warfare is concerned. I knew you were connected with it, but I just didn't quite know the connection. I am glad that you have told me. Doctor, my association with your Commission has been very pleasant, with Mr. Gordon Dean and yourself and also with the various agencies of your Commission that have to do with the beneficiations of uranium ores. You have now allocated a project to the University of Nevada, which I like to think I am responsible for by going in and calling your attention to our Mackay School of Mines. AEC has already allocated $60,000 for the first year of work there, and the idea is to discover new methods for beneficiation of uranium ores or devise better methods, trying to make lower-grade uranium ores commercially available. In other words, the only difference between country rock and ore out in this country is a better proven method of beneficiation, so we hope that the low-grade uranium ores in this State will become commercial at some future date. We also have under consideration their radiation dust experiments to determine the effects of radioactive dust on animal and plantlife and water and soil. I am sure that they are going to allocate a project to the university, the biology department, to continue those studies which you are now conducting and will continue. Of course, you are entirely familiar with the operations in southern Nevada on experiments with atomic bombs. We are becoming a very important unit in your work. Would you tell us something about the hope you have for the development and actual use of commercial power by this new fuel, and the status of it in your own words, and about the areas under consideration, at least so far as they refer to our State of Nevada?

Dr. HAFSTAD. I will be very glad to do that. I hope you will feel free to break in at any time with questions, because I have no prepared statement, so to speak. I will speak "off the cuff." I welcome this opportunity to report to your committee, as I do to all other such committees on the subject, because I think it gives us an opportunity to

correct two general misconceptions of atomic energy. One is that it is so secret that you can't talk about it, while actually many of the basic facts are such that they can be made available to the general public, or a committee such as yours. The second is that it is necessarily so abstruse and difficult to understand that it is hopeless for a man to try to understand atomic energy. I think both of these things are misconceptions, and I hope to indicate, if I may take a few minutes, why it is I believe that any lay group can and could begin to think in terms of what atomic energy is and what it might and can and probably will do over the next several decades.

Senator MALONE. Then, Doctor, as I understand you correctly, out of the volumes and volumes of information and laboratory experiments, some of which I am familiar with and others which are of such a confidential nature that I have not yet got around to investigating—much of this information leading up to the real means of exploding bombs and so on, is unclassified. In other words, perhaps 75 or 90 percent of all the information is unclassified; it is only the very important results in the matter of importance to warfare that are classified. Would you give us some idea of what percent of all this information is unclassified.

Dr. HAFSTAD. It is pretty hard to give it in a percentage basis, but the critical numbers that are essential in making a bomb a success or a submarine a success and so on, are classified and highly classified. I think that as we go on with our discussion you will sense that many of the basic numbers that are needed to assess its value for civilian purposes are essentially unclassified.

Senator MALONE. In other words, you could tell it to any citizen in the United States?

Dr. HAFSTAD. You could tell it to any of the citizens, and many of the technical people and engineers are following this very, very closely.

Senator MALONE. Now, Doctor Hafstad, in line with your discussion, would you also give the committee information concerning your previous visit, and discuss the suggestion you made for setting up a technical committee that would be cleared for such classified information as might be necessary for this particular project the civilian committee you suggested be set up? That course was followed through by Mr. A. M. Smith, former Nevada State engineer, now my administrative assistant. He has handled that work and in your discussion you might also——

Dr. HAFSTAD. Let me start off on atomic energy. The important thing in this whole atomic energy game is that we have an extremely concentrated source of energy. As the Senator said, 1 gram or 1 pound—it depends on what units you are using—we will say 1 pound of fissionable uranium 235, will release as much energy as you can get from 2,600,000 pounds of coal. It is an extremely concentrated fuel, if we want to speak of it in those terms. Now that fact in itself suggests that it ought to have its greatest advantage in regions of high fuel costs, or particularly where the transportation of fuel is an important item. We will come back to that point, but first I want to say that back in the old days when we first started working with the atomic energy chain reaction, it was quite clear to the scientists involved, that the problem was one of control. Once it was demonstrated the energy was there, it became apparent that there are two directions in which you can steer this as you learn to control it. One

is toward faster and faster reactions, which leads you to explosions, and the other is toward slower reactions which leads you to use of atomic energy as power, or as a power source. I would like to give a relatively crude analysis here so that you can understand what is involved. Most laymen think that when you throw a lighted match into a barrel of gasoline, you have an explosion. You do get a lot of flame and so on, but this is not a good explosion from the point of view of an ordnanceman who is used to dealing with really high explosives. You have to do a lot to get explosives to burn rapidly enough to be really effective. Similarly, moving in the other direction, you can't get useful energy slowly out of a barrel of gasoline just by throwing a lighted match into it, you have to do an awful lot of engineering, and planning and timing and designing in order to get an ordinary automobile engine to use the energy.

Senator MALONE. That is your combustible engine, the gas engine that developed gradually and took years and years to perfect.

Dr. HAFSTAD. It takes many years of development to do this, and I wanted to cite this and say that we are up against exactly the same thing as far as atomic energy is concerned. We pushed first under the stress of the national situation into the direction of faster and faster reactions, and out of this effort has come the atom bomb which you have all heard about. Simultaneously, and with considerably less public discussion, we have been pushing in the direction of controlled reactions—a slowed-down atom bomb, if you like—to extract the same amount of energy and turn it to useful work. Now, quite clearly, this is going to be a difficult job as was clear to us in the beginning. It is going to be very expensive, and for this reason, our first effort—our first way station, you might say—in the direction of ultimate civilian power is relatively uneconomical power, but nevertheless necessary power for the naval and aircraft mobile reactor program.

Senator MALONE. This is your department and you head it?

Dr. HAFSTAD. That is right, and this is a deliberate campaign to learn how to control atomic energy in the places where it will pay the most dividends.

Senator MALONE. And as to reactor that you are building in the submarine, expense of the power is not what matters most, because power is already expensive in the submarine, and its importance overcomes its cost, so you are not so interested in the cost.

Dr. HAFSTAD. That is quite true. I would like to give you some numbers on this, indicating again that the information is available to interested persons. Checking with the Navy Department I found that the cost per kilowatt-hour on a major capital ship, aircraft carrier, or battleship is in the neighborhood of 2 cents per kilowatt-hour. In a submarine—a conventional submarine—it is 8 cents a kilowatt-hour. And in a really fast submarine, using special chemical fuels which will give high speeds, it is up in the neighborhood of a dollar and a half per kilowatt-hour. So this gives us quite a leeway even though the atomic energy business is expensive. We can compete with figures of that kind. This, then, was the first step of our campaign; to learn how to control reactors and put them to some kind of useful work.

Senator MALONE. As to your advantage in the submarine: What are some of the advantages of the uranium fuel over other fuels in

the production of electric energy to run the submarine, advantages in the matter of sustained action and space in the submarine required for the reactor over the space required for other types of fuel?

Dr. HAFSTAD. Well, I think here the exact numbers are highly classified for military security reasons. On the other hand, the numbers that I have already given you, give some indication of the savings which can be made. If you like, we said 1 pound of atomic fuel is equivalent to 2,600,000 pounds of coal. Now the energy in coal and in fuel oil is essentially equivalent. Let's divide 2.6 by 2,000 to get tons and you will get about 1,300 tons. So, in a submarine where, as all of you know, space is at tremendous premium, you can replace 1,300 tons of fuel oil with 1 pound of fissionable material. Your cruising range then goes up proportionately. For every pound of fissionable material that you carry along you have the cruising range of 1,300 tons of other fuel. I think in short, for practical purposes, your cruising range submerged—and that is important—becomes essentialy indefinite and can be as long as you want. You see, the conventional submarine runs on batteries and uses diesel power to charge, so you can run on batteries submerged only until the battery is run down. That is a short time. Then the submarine has to come up and surface and either lie along the surface if it is the old-fashioned submarine or, if newer, lie partially submerged in order to run diesel engines and recharge the batteries. This is a very dangerous operation. With the nuclear-powered submarine, that operation is entirely eliminated and you can run continuously under water. These are some of the byproduct advantages that come out of what we call the mobile reactor program for submarines, and so on.

Senator MALONE. Then too, in constructing this submarine reactor you learned something that made progress in the commercial field where you are now trying to figure out what the cost would be for a commercial plant?

Dr. HAFSTAD. I would like, in connection with that point, to stress the history of the diesel engine. Most lay people don't realize the extent to which many of our everyday things have been developed initially for specific military purposes. The diesel engine started in Germany, subsidized by the then ambitious German Navy, way back before 1914, and was pushed on by the Germans in connection with their development of submarines. It was picked up by this country and carried through on a development basis for the Navy in order to produce what were then modern submarines. As soon as our industries learned to build diesel engines, which took quite a long time and was a difficult assignment, they then began to be available for civilian purposes, and now there are two really major uses for diesel motors that have grown out of this strictly naval use. The first, as you know, is for isolated power plants such as you have all around in the West here where you can't get imported power from big stream stations or hydro plants; the second is on our railroads. The diesels have practically replaced the conventional steam engine. I believe it is some years now since the old-fashioned steam engine has even been constructed in this country. I don't think people realize the extent of which diesels have replaced steam. All of this development, and it is a big new industry, arises from the original development for the Navy. I think we will go through a very similar cycle with respect to nuclear power. There would be developed nuclear power

plants for military usese by which we will learn the techniques which will enable us to make economic power for civilians.

Senator MALONE. What you clearly indicate is that all these developments, even going back to the invention of the wheel, the steam engine and electricity is that nothing happened all at once, it wasn't just by waving a magic wand and all at once they had a perfect wheel, and all at once they had a perfect steam engine, and all at once they had a perfect electric generator, but all of these things, especially the generator and steam engine, it took almost a century, or a half a century anyway, to perfect.

Dr. HAFSTAD. That is exactly true. It takes decades to develop any of these new revolutionary inventions.

Senator MALONE. We used to hear about diesels in the First World War. You couldn't start them when you wanted to start them and they were liable to stop at any time in some mysterious manner and you had to have a diesel expert to get them running again. There were only a few in the world, so they weren't practical.

Dr. HAFSTAD. That is the history of practically every new major technical development, as you well know as an engineer. Going on from there, the goal that most of us connected with the atomic energy business have, and feel is necessary, is that we should, in the long run, make this unique new power source available and useful for civilian purposes. We are, of course, working hard on developing it for military purposes at the present time, because this is what the international situation calls for. But back in all of our heads is the hope that somehow or other we can turn this to ultimate civilian good, and this is largely in the direction of utilization of this energy in power plants for developing electric power. This is not out of the question. We are approaching that stage at the present time but we haven't gotten there yet. This is the reason why I think we should take a few minutes to discuss the present situation in order that there can be no misunderstanding as to what it is. I have indicated that we can extract power from this new fuel for running submarines. In this case you have to design very expensive equipment because your planning is very difficult in the submarine; you are cramped with weight and space limitations. You can always build a cheaper plant on land than you can on a navy vessel, so we could make some saving in that regard. However, we have some very difficult technical problems to overcome in the reactor field which we can't short-circuit, and I will have to take a few minutes to list some of those. In the first place, ordinary construction materials such as we are used to, and familiar with—steel, aluminum and all of these other materials—cannot be used for several reasons. In reactors we contend with high temperatures. The atom bomb itself is an example of the temperatures that are available to us. We, as nuclear engineers, have temperatures up to 10 million degrees centigrade available, but at those temperatures, everything evaporates, including tungsten. So we can't use ordinary construction materials at high temperatures. Whatever materials we do play with will have to be materials which will stand high temperatures, and there are very few.

Senator MALONE. In that connection, the Bureau of Mines has played a very important part in the development of structural materials.

Dr. HAFSTAD. First, then, is the point of temperature, but that is not all. We must have materials which will stand up under the intense nuclear radiation that you have inside of the reactor. As the reactor runs, you produce these neutrons that you have been hearing about, and they bombard the materials; and you produce the usual alpha, beta, and gamma rays that are associated with radium, and they bombard the materials. So the tendency is for the materials to change their dimensions and to lose their mechanical strength and so on. Very few materials are available to us for that reason. Finally, there is a third condition, and that is that since the chain reaction itself—this is the thing which gives us the energy—depends on the availability of a large number of neutrons, if any of these neutrons are captured—eaten up is the word we use—by other structural materials in the reactor cells, this reduces the number of neutrons available and essentially puts the fire down. So we have these three conditions that we must meet with all of our materials. This means that we have to develop brand new materials, and that is a tremendous problem. One of these which we developed as a new material for the submarine reactor is the metal zirconium. You people out here have seen titanium grow up from practically nothing into a major industry. We are doing exactly the same thing with zirconium. Whereas a few years ago zirconium was a chemical which you made in chemical laboratories in little bottles, we now produce zirconium by the ton. As you know, titanium is moving into the tons-per-day category. I predict zirconium will do the same thing. Here is the sort of thinking that has developed something for one purpose and then it becomes available for other purposes. Zirconium, then, is available to us as one of the materials for reactor construction. As these new things become available we can make our reactors cheaper and cheaper designwise, because much of the development work has been paid for, and when the cost comes down, then the possibility of producing competitive electric power, electric power which will compete with the power from coal and oil, will gradually come into the plan. Now, however, in the current early stage, if we are going to compete, we have a high priced method of production, so it must be in the high power cost areas. I think this begins to indicate why it is that we in the Commission have long been interested in any and all high power cost areas in the United States, and why when Senator Malone and his associates brought this Nevada location to our attention, we were immediately interested. What we want then for a first demonstration of practical electric power is a location where in spite of our relatively high production costs at the present time we can begin to deliver this electric power to a using industry of some kind and do it in a practical way where even though our costs are high we can compete with power from coal and oil. We could never, at least for the foreseeable future, compete with waterpower, because that power cost is very low.

Senator MALONE. You mean present low-cost hydroelectric power for example? Of course, with newer hydro power being developed today, they are considering increasing costs as high as three-fourths of a cent.

Dr. HAFSTAD. There is another point which I think should be stressed in a hearing of this kind, while the cost on the busbar can be very low, the cost of transmission is the big element in any electric-power project. We were discussing only the cost of generation for

electric power. I don't think it is generally realized the extent to which your transmission costs enter into the cost which the consumer has to pay for his electric power. This suggests that in areas remote from either big hydro installations or local coal and oil supplies, it might be cheaper to truck in a pound of uranium or something of that kind, and run on that instead of hauling in many tons of coal or oil or building an expensive transmission line. This is another way of emphasizing the fact that uranium will probably begin to compete first in high power-cost areas.

Senator MALONE. You find those places mostly in wide stretches of desert and mountainous areas where there is no concentrated demand for power, such as there is in San Francisco, Los Angeles, Las Vegas, or Reno. Where the mining industry and the pumping of water and all development depends on low-cost power, but where there is no load sufficient to justify a long transmission line?

Dr. HAFSTAD. That is something which those of us who have been in the atomic-energy business for a long time feel to be true. The mining industry, which often operates in the most peculiar places you can imagine—the most remote areas—would be one of the first to cash in on the unique advantages of atomic power. So, it is not a surprise to us at all that regions such as the intermountain States out here should be very much interested in atomic power.

Senator MALONE. Now, of course, you remember when I first discovered you, you had been discovered by many other people no doubt, but I discovered you for myself, I was trying to find someone who was interested in the examination of just such areas. I remember my first remarks to you, not knowing you were quite as interested as you have been, I tried to explain to you that the mountainous areas, eight States between the Rocky Mountains and the Sierra Nevada, had very little power available, and some States like Nevada have no fuel, no oil, or no gas. In isolated areas where it is 150 miles to the next town and that town very small, the population depending entirely on mining operations, livestock, and limited agriculture, that there were many areas of potential greatness. I mentioned a few to you at that time, one of them being Eureka, Nev. I stated to you that I thought it was worthy of an examination since there was an estimated 12,000 gallons per minute of water to pump 2,500 feet to make available 100 to 150 million dollars worth of lead and zinc which are strategic metals wanted very badly by the Government and where there were around 8,000 kilowatts of Diesel-electric power installed costing about 3 cents per kilowatt-hour to operate which has been shut down because of the high cost. I requested you to examine at least that one area and I believe as a result we did set a chain of thinking in motion as you have just described, where wide undeveloped areas might be first to benefit from nuclear power. Realizing that every time you would build one of these reactors the cost would become less, as the fuel-cost production became less it would be come more competitive and move toward the center. Then, of course, I hope, and I know you are in unison, that sometime you could build a plant right here at Henderson for supplemental power. You did then consider this mining camp at Eureka and that is still under construction?

Dr. HAFSTAD. That is very true. Of course, coming back to that, I think one of the difficulties that we have had in our overall surveys to see where and how we could begin to contribute power, is that most

broad studies are based on average power costs, the average for the State or something of that kind. For this purpose that doesn't mean a thing to us. What we need are the isolated little local areas where there is a reasonably firm demand for relatively high-cost power. I think making this kind of information available to us is one of the very great services which Alfred Merritt Smith here and his groups have been able to do. I hope we get similar studies from other parts of the country, because any and all of these demands, I think the Commission would be interested in. So far the reports that Alfred Merritt Smith has sent in indicate that Eureka comes close to meeting most of our requirements. There is a demand for a comparatively substantial block of power, a continual load, and it is in a rather isolated area, which keeps us from worrying too much about the possible hazards of location. All I can say at the present time is that the Commission is still interested in a study of all these locations and the Eureka location remains high on the list. To indicate that this is a little more than my personal reaction, I think it would be well to read into the record here some of the Commission's statements on this subject. I would like to quote here from a speech given by Gordon Dean in San Francisco, Wednesday, September 17, covering more or less the same ground we have covered here. He says:

Most recent experience has shown that there is a real hope that these costs, the cost of reactors, can be substantially reduced. This experience has come from the reactors we have more recently completed or are now working on. The reactor we are now building to power a submarine is one example of the kind of places where we are picking up knowledge and experience upon which reasonably valid predictions of future costs can be made. There are other examples among research and other reactors we are building. To illustrate what I mean, let me discuss just one specific example. Recently we completed construction on and placed into operation a new reactor which is operating successfully. When this reactor was first thought of it was believed that it would cost about $50 million to build it. The actual final construction cost was not $50 million, but $20 million, and now I am told by some of our scientists that they feel they can take the lessons learned on that reactor and build a somewhat smaller but essentially similar machine without the costly research features of the original one, for as little as $5 million or possibly even less. When you get into this range the cost of power from such a machine begins to be interesting, not because it would compete generally with power from coal, oil, gas, and falling water, but rather because it looks like it might begin to become competitive in a few isolated locations where normal power costs are extremely high.

This is what we have in mind at the present time. I have another statement from the chairman which I think should be read into the record at this stage. It is a letter from Chairman Dean to me.

DEAR MR. HAFSTAD: I am glad to learn that you will have an opportunity next week to explore with the members of the Public Works Committee of the Senate some of the problems which face the Commission in its endeavor to secure useful power from atomic energy. There has been little question in the Commission's mind that in high-cost fuel areas reactors might appropriately supply power. I hope, however, that you will be quite frank with the committtee in explaining some of the difficulties, including the legislative changes, that will be required before we can induce private enterprise to come in and participate with risk capital in the construction of such power units.

Senator MALONE. I think that is very interesting. I am glad you read the letter because most of us have in mind that is what you would construct at Eureka, providing that decision was made, and no doubt decision will be made to construct it in such an area or at least in a similar location, because of the fact that if you put it in a fuel area

like southern California where they have abundant cheap oil and gas available and can make steam power for around 4 to 4½ mills you would lose considerable money per kilowatt-hour. Here they are so power hungry that you not only get the cooperation of the entire community and of the State at whatever cost you finally arrive at, even if it should be a cent and a quarter as was first named as a possible figure and a target to shoot at, or even twice that amount. It would still be somewhat cheaper than any other power supply obtainable in remote mining centers. Now in the matter of the difficulty of legislation, Mr. Dean has discussed that with me at different times and I am sure he has with other Senators. Knowing my inclinations toward private industry I would hope along with you, and I have heard you express your opinion, that you have to construct one of these power plants you might say at fifteen, twenty, or twenty-five thousand kilowatts, and that the power cost would be such that it would interest private capital in these various areas to continue the construction and that you would then only become more or less a supervisor, like you might say the Interstate Commerce Commission or the Communications Commission. There are many engineering problems to be worked out as to how you would issue permits to a private company, is that true?

And they must be well controlled at first until such plants become plentiful. Would you outline, if you can, some of the problems in the national legislation and perhaps the State problems also? In other words, you have what you call a national jurisdiction, interstate, and you have what you might call an intrastate jurisdiction and we would have our own problems.

Dr. HAFSTAD. In any new development like this, particularly in this one because it is so apparently different from anything we have ever done before, there are many new problems raised and I would like to separate these problems into two categories, the technical and the nontechnical. The first part of this discussion we have been holding pretty close to the technical type of thing and we are now moving into the nontechnical areas. There are many complications that get into the picture here.

I said that much information was available in an unclassified way for public discussions of this kind. I hope I have indicated that there is a fair amount. However, when you come to actually designing and building a reactor, then you need to know the actual numbers, the actual physical properties of the materials. This happens to be classified. So, how can private industry come in and bid, so to speak, in the construction of one of these units when they are not allowed to know the numbers on which to base their calculations? So you have a security problem. Then, as you know, radioactive materials are inherently dangerous for uninformed people, so you have a radioactive hazard. There is always the possibility of accidents if things aren't properly designed. So you have what we call the hazards problem here, which I think should be taken into account. All of these things are technical problems but they are tied in with the legislative problems when it comes to the question of release of information.

Senator MALONE. It would be a matter of national legislation to empower the Atomic Energy Commission with the authority which they do not now have to deal with industry.

Dr. HAFSTAD. This is particularly true since the Atomic Energy Act specifies that a good deal of information in regard to industrial use and material shall be kept secret. This means that we can't talk completely freely to any of these industrial companies because if we did talk in the open this information would immediately go across the waters. So we have this security problem, then, on detailed technical information. We have, in addition, the fact that by the law all fissionable materials must be owned by the Government, so that conceivably, the plant, or part of it, might be owned by private industry, but the fissionable material, which is the core of the whole operation, must be owned by the Government.

Senator MALONE. That might be similar to a situation that we have at the Hoover Dam. I was State engineer and Colorado River commissioner when we passed legislation for the Boulder Dam Project Act in Washington and constructed the dam. I was consultant to the Secretary of the Interior about the power problems. They had one man from each State in the basin. We there determined not to put in the generators but allowed private industry to put in their own generators, and to sell them falling water, which the Government owned. The reason they owned the falling water was simply because it was a multipurpose dam for flood control, silt control, power, and irrigation, and no private company could go in and construct that dam. It cost $160 million then, it would probably cost $350 million now, to take care of all these various factors. If they—private industry—could have done that they would have. So, then, public money was put into this project and underwritten completely before they started construction, through the sale of the power and water, but we sold the power lessees the falling water, and let them put in all their machinery. In this we might have a parallel to that situation.

Dr. HAFSTAD. It seems to me there is very good analogy here because, since the Commission must own all fissionable material, we control the raw-material supplies. So, again, it is a peculiar situation for private industry to come in on where the raw material on which their whole activity is based is not under their own control. This is another of the technical problems that gets into the picture. So, whereas the Commission is very anxious to bring in private industry—and, as you have probably read in the paper, they have brought in 4 or 5 different study groups to consider this problem—it is not a straightforward operation where private industry can come in, make a bid, so to speak, and begin to build these things.

Senator MALONE. Doctor, I have not only looked at the papers, but I have read the reports, and also Secretary Finletter's letters to me and all the other private information, classified information which I cannot use. So, I know your problem thoroughly, and I know these companies are very, very much interested. In my humble opinion, the construction of the first pilot plant on a commercial basis will show the practicability of it just as you have pilot plants to determine the practicability of making petroleum fuels from oil shales and pilot plants to determine the practicability of making petroleum fuels from coal. I have sat there on my own committee, the Senate Committee on Interior and Insular Affairs, as we recommend the appropriations for these pilot plants and I hope to be in a position to recommend the appropriation you need for this pilot plant. But knowing all the

background of this and not being able to disclose it any more than you can, I hope—and our hopes have been justified by your appearance here—for you to separate the wheat from the chaff, what is classified and what is unclassified, what any citizen can learn and what only men cleared for the information can be allowed to have. You and Director Gordon Dean and all of your associates have a very great responsibility in this matter. If any information leaked out or any of this material escaped and was lost you are responsible for it. Therefore, in your pilot-plant construction, there would be part of it a very highly classified deal and part of it open for the public, but any of that material that was lost you would be responsible for.

Dr. HAFSTAD. That is part of the security picture. On the other hand, speaking for myself, for these reasons that we have been discussing this morning, it seems to me that unless we can find ways and means whereby private enterprise can, with greater assurance, put their own money into it, then it is highly likely that somewhere in these United States the Government will be spending the money to build a pilot plant producing electric power. This is going to be a borderline thing economically. I don't know what the cost will be; nobody knows at the present time. But, sooner or later we will have to take this step to see how cheaply we can do this.

Senator MALONE. That is a step that is definitely under consideration and where Eureka is under consideration.

Dr. HAFSTAD. Eureka is still in the picture along with all other parts of the United States. I think that just about makes the picture as of now.

Senator MALONE. I think it does. I would like to ask one more question. I know it is a very problematic thing, you have heard my partial summation of the hearings that we have held here. We are in a very critical situation as far as our Henderson industries are concerned, and that is about all the industry that we have in this area. We have this industrial center. We have added one industry after the other. There are 7 or 8 industries here feeding off one another and it is a very important industrial center. Now we have been showing for the last 3 or 4 days that they are short of power, critically short of power for the investment that has already been made. In other words, we are unable to reach the maximum production of titanium, one of the most vital metals in the whole world, at the present time, as you well know, unless we can show and unless we can secure additional power for the capacity justified by the investment already made. In addition to that, they want to increase production of titanium to 40 tons a day where now it is only about one-eighth of that amount.

They hope to have the first 10-ton unit in production this year. They have now taken an additional contract, due to the Shasta power contract to make that power available but they are now stymied for further contracts until they have the assurance of more power. I have already outlined the sources we are examining. The critical part of it is that if they do not secure the power they must move elsewhere. If they separate the plants and start producing under the same conditions elsewhere, there is a danger that this area might eventually disintegrate, and some of these industries that are located here would move to those other locations. Now with that power shortage, the critical vital thing, wouldn't it be increasingly important, in your opinion Doctor, to hasten the construction of such a pilot plant

knowing, as you have often told me, that with every plant you construct you learn how to build the next one at less cost, it will hasten the day when the power might cost less than a cent per kilowatt-hour, or at least get into the field where it could be used as supplemental power under the situation that I have described here?

Dr. HAFSTAD. It will require study to answer all of that, but it is certainly true that unless we continue to build reactors we won't learn these additional things which are necessary to bring the costs down. Every step we take in this direction will further improve the technology, so to speak. In listening to your summary of testimony here, among the thoughts that were going through my mind was that one of the other advantages we will ultimately get from nuclear power is that we can take the power to a mineral deposit because of the concentrated form of this energy. It shouldn't be too hard to bring the power to the mineral deposit, instead, as we have done up to the present time, of hauling these tons and tons of ore out to somewhere where you can get the energy for processing. So this, I think, is fundamental as far as the mineral picture is concerned.

Senator MALONE. In other words, it went back to World War II where we had the most enormous magnesium production in the world, knowing it was a temporary production, that it would be uneconomic in peacetime, but it was absolutely necessary in wartime, that we transported the ore 250 miles and often shipped from Gabs, Nev., to Salt Lake City and from Salt Lake City back down to Henderson. But millions and millions of dollars could have been saved in the reduction of that ore if we were at the same stage that we are now. It would be very likely that a plant such as we are now considering could have been constructed at Gabbs.

Dr. HAFSTAD. For special needs like that, we would be interested. I think in short, this gives us a chance of bringing Mohammed to the mountain instead of the mountain to Mohammed.

Senator MALONE. So that, this without any commitment on your part, which I do not ask as far as our own Eureka is concerned, knowing that you are now in the process of investigation, but that such a site as Eureka where there is a 3-cent a kilowatt-hour cost and the mines are shutdown on that account and the pumping of water in the area and various other operations are not feasible, some such site will be selected that will make your first pilot plant the most economic possible, let me put it that way.

Dr. HAFSTAD. In my personal opinion, that is true.

Senator MALONE. And that there is such a real need for such a pilot plant, not to help any certain area but to approach and arrive as quickly as possible to a condition where such plants as you can build will come down to a cost where they can provide supplemental power for such operations as are here at Henderson now.

I don't know how far you have gone into the power field. It has been my life for the past 30 years. You might have 2-mill power, which they have at the switchyard here at Hoover Dam. We have something like 2½- to 3-mill power at Davis Dam, 50 miles below, and we have a fourth of that dedicated for our use. Then we shall be getting power from Shasta Dam which will be considerably more expensive due to the distance, maybe 6 or 7 mills, I do not know. But with a large amount of real low-cost power, then a supplemental supply, even if it costs a cent or a cent and a half, but average cost is what

you are looking for. So that such a center as exists right here at Henderson, providing you construct your power plant at Eureka or some such place, and you cut the cost down below a certain quota which you have said that at one time you hoped to reach with the production of other material, you wouldn't have to cut it very much to make some excess power available as supplemental power to an industrial area.

Dr. HAFSTAD. This comes back to the point I tried to make before, that I believe the price where we can first begin to compete is in these relatively small blocks of high-cost supplemental power.

Senator MALONE. And you have to start somewhere, that is to say, if you want to do the best economic job for the Government, which I know you do, the higher cost of power in the area demand, the sooner you will become commercial, produce commercial power.

Dr. HAFSTAD. Well, commercial power * * *

Senator MALONE. What I am trying to say is, commercial power in one place would be out of the question as commercial power for another place. In other words, feasibility as a relative term. What would be feasible in Eureka would not be feasible at all in this area.

Dr. HAFSTAD. What I was going to say is, the sooner we have a demonstration of an economic or near-economic block of power somewhere in the country the sooner private industry will pick this up and develop through with their own resources.

Senator MALONE. Mr. Neilson is here today who represents the Bureau of Reclamation in this area. Would you tell us the progress you are making with the Bureau of Reclamation in examining this central Nevada area for a power demand?

Dr. HAFSTAD. In Washington we have made a request to the Bureau of Reclamation for an essential overall survey of the high costs of various high-cost power areas in the entire country. Most of these fall in the intermountain States out here. I believe for this reason it is almost a foregone conclusion that it will be somewhere in this area that these special opportunities emerge. Now the correspondence is just under way. The governmental machinery is grinding on this and in due course we will get the answer and the result of this survey back. Cost is only one of the factors that we have to consider in choosing the locations. That is the credit that we get for the power. We will have to consider such things as strategic safety against enemy attack. I think that is one of the things involved. We will have to consider the availability of cooling water, let us say, for the power plant. We will have to consider the construction cost index at the particular location. If this thing happens to be way on top of a mountain peak somewhere, we might lose all of the money that we expected to save in high construction costs. All these factors will have to be weighed before the final decision is made.

Senator MALONE. On the matter of strategic safety, perhaps in the intermountain area, between the Sierra Nevada and the Rocky Mountains would be about as safe as you could possibly find.

Dr. HAFSTAD. From that point of view, this area, I think, will get a fairly high rating.

Senator MALONE. And the cost—being within a few hundred feet of a good concrete highway—shouldn't be too excessive in that area.

Dr. HAFSTAD. I would rather not make any comments on these things. They are just factors that have to be taken into account.

Senator MALONE. I think, Doctor, that you have covered the situation very thoroughly, especially the importance of proceeding with the investigation. You have now reached the small plant stage to determine the practicability of it. And every time one of these reactors is constructed it is your opinion that the cost will come down?

Dr. HAFSTAD. I think there is not much question about that.

Senator MALONE. There is also a little question, is there not, about the reduction in quantity of fuel, the many thousands of tons of present fuels, that must be used to equal a small amount of reactor fuel? There is no question but what the cost of reactor fuel would come down if the damand for the fuel is larger, is there?

Dr. HAFSTAD. I think, at the risk of getting a little technical here, I would say that one of our hopes and expectations is that we can skip the large element of this high cost by so designing the reactor that we take essentially natural uranium and run the reactor with that uranium, using the fissionable material which appears in that to start the reaction, and then run what we call the breeder reactor so that the fissionable material which is in the natural uranium in the first place starts the chain reaction, produces more fissionable material and allows us to burn up in place within the reactor more of the fuel. This is the way I think we will get the ultimate really low-cost power, because it saves many of these other steps.

Senator MALONE. In other words, you are approaching the situation in that regard as in the starting of a jet plane. A real concentrated high test fuel is being made right now here in the Henderson area for a take-off fuel for a jet. Once it is in the air it runs on another kind of fuel. You don't use that expensive fuel all the time.

Dr. HAFSTAD. Well, you see, we can make our high grade expensive fuel as we run the reactor itself.

Senator MALONE. I wish you would explain a little more about that breeder reactor; of course, that is an uncanny thing.

Dr. HAFSTAD. Natural uranium as it is found in nature consists of two kinds of uranium. To a chemist they are exactly the same; it is all uranium. To a physicist there are two kinds of uranium because one has a mass of 235 units and the other 238, that represents the weight of it. The U-235 is the fissionable form of material which can be used for reactors or bombs.

Senator MALONE. That is your more recent discovery, say 10 years ago—or more recent—when you began to split the atom?

Dr. HAFSTAD. That is the fission process which was discovered, and this goes on only in the 235.

Senator MALONE. The 238 has been known for a long time?

Dr. HAFSTAD. That is right. It also happens that only seven-tenths of 1 percent of uranium metal as found in nature is of the fissionable kind. So at these plants that you mentioned we separate out seven-tenths of 1 percent of the uranium and store the rest of it which is waste material at the present time. Now it happens also that you can take the neutrons from the chain reaction, from the fissionable reaction, let them bombard this useless U-238, and through a series of radio-active transformations, you will come out with another fissionable material, plutonium. This is the stuff we would lean on as far as the breeder reactor is concerned. We would design the reactor to have a large amount of U-238 present surrounding the reactor core so to speak, and any of the neutrons which escape and come drifting

out from the central part of this reactor would be captured by the U-238. Every few years we would take this "blanket" as we call it of U-238 which surrounds the central core, and chemically process that and extract the new plutonium that we just produced, put that into the central core and start up again with new uranium on the outside.

This multiplies the available total energy by the ratio of 238 by 235, which is 140 to 1.

Senator MALONE. In other words, the ratio of seven-tenths of 1 percent as against 100 percent?

Dr. HAFSTAD. That is right, so it is 140 to 1. Now this, then, is the breeder reactor. I always hasten to emphasize that this is not perpetual motion or anything like it, because this process will go on only so long as you have U-238 to convert into plutonium.

Senator MALONE. So you do have to go through this gaseous diffusion method of producing this fuel or through some similar method of reducing the fuel to start with, but which produces 140 times the natural amount of the useless 238, that is useless for fuel as against one part of fuel? So, you have discovered this method of making that 139 parts available as fuel at no extra expense, you might say, as you operate your reactor?

Dr. HAFSTAD. I would express it in another way.

Senator MALONE. In other words, when the U-238 is used we naturally have to make some new U-238, so it is 140th as expensive?

Dr. HAFSTAD. I think the picture is even better than that. I would say that because we have been running the diffusion plant at Oak Ridge and making 235 for bombs, we have accumulated an enormous store of the zero value useless U–238. Now with the breeder reactor, without any further expense for raw material, we can dip into this ash pile at Oak Ridge and begin to extract electrical energy. This is what we would really like to do.

Senator MALONE. Of course, that is uncanny. Well, it all is uncanny when you come down to it, but your commission is whipping these problems one by one and sees nothing in the way of making atomic power entirely practicable at a competitive price in the reasonably near future if you can go ahead as you would like to go?

Dr. HAFSTAD. I think we see our way clear through the technical problems; from here on the question is one of economics.

Senator MALONE. As to economics, we have a situation here. Our titanium that we are producing here at the plant costs $16 a pound. During World War II it was $44 a pound. Now we have reached a condition which I am trying to break, or rather the Senate Public Works Committee is trying to break, for I just happen to be chairman of this hearing. I am trying to do this in other ways. I have conferred with Secretary Finletter, head of the Air Force, and with Jess Larson, Administrator, General Services Administration, which finances all of these organizations. I have a letter here that I cannot make public, telling the extreme importance of getting titanium at a lower cost if you are going to use it for commercial purposes and all the commercial air organizations have stated at this hearing that they need this metal very badly. The words they used to describe how much they need it are very strong. In both classified and unclassified information regarding titanium, it is clear that fighter planes must now be largely constructed of titanium; that is the vital parts. Some of the officials thought in order to let the contracts without embarrass-

ment when it goes before congressional committees, that they must get the cost down, and in order to get the cost down they must let more contracts for construction, so the bottleneck is who is going to take the first step, and that is your problem.

Dr. HAFSTAD. I am afraid this is a sort of the hen and the egg problem which you always go through.

Senator MALONE. That is the reason this committee is getting into the business right now. This transcript will be available to the Senate Public Works Committee in January. They will hold hearings until May or June next year and then the session is over. The committee hopes, at least speaking for one member of the committee, to cooperate with you in your work of breaking, what might be called the bottleneck. Whatever the first cost, you must construct the first plant and find out the most economical procedures, just as it is in the manufacture of titanium. In my opinion both are indispensable in the national defense effort. I could probably dig up 50 places where it would be feasible to build the plant becaues of presence of strategic minerals. These places would be in areas where power is needed but the cost of it is too high from other conventional sources. I have only brought one location to your attention, so as not to confuse the issue.

My assistant, Mr. A. M. Smith, has prepared reports on this entire area, which have been made available to you. Mr. Smith is the chairman of the technical committee which you asked be set up and they have delivered a report you need. Would it be possible—I have discussed this with you before and we have good air service from here and Reno and to Eureka if it is necessary—while you are here for you to take another look at these areas for another 24 hours before you return to Washington?

Dr. HAFSTAD. Well, my special orders won't permit it this time, and I don't think that is the critical thing that is needed. I am reasonably familiar with this. I think the next stage would be to get all other areas up to about the same stage of information as we have on Eureka and then send out engineers. You are ahead, possibly due to Tom's (A. M. Smith) work here, in getting in the information on the Nevada area. We have to get all the areas up to the same state, then we will probably send a crew of engineers or technical people around to check into each one of these and that is the stage when we have to get down to brass tacks.

Senator MALONE. That is to state, you will lead your crew on another trip here just before your final decision? Well, doctor, I speak for the committee, I know; I want to express our deep appreciation for you coming all the way from Washington to give us this information. Anything, speaking for one member of the committee, that we can do to further your work, we will do.

Dr. HAFSTAD. I think it is important and we are going to try to carry this thing through successfully. Thank you very much.

Senator MALONE. I will see you Doctor, after we adjourn the hearing. Thank you. We have Mr. George Hardman here. We will divert now to the six irrigation bills that have been introduced to irrigate approximately 241,000 acres of land in this area, the southern Nevada area, from the Colorado River water sources. That would be from the Virgin River, from Lake Mead and from Lake Mohave and whatever source proved most economical along the river. George, would you come forward now and identify yourself for the record. I

wish to say at this time that I appreciate Mr. Neilson, who is head of the Bureau of Reclamation in this area upon whose shoulders will fall the responsibility of every investigation that the Bureau might make in this area. He has left some very important work this morning to be here to hear your testimony, George, and the committee appreciated your presence. Identify yourself for the record, and proceed in your own words. I know you are familiar with the area, as you are of the entire southern portion of the State, in your work. Your testimony, I anticipate, will be very valuable in this regard.

STATEMENT OF GEORGE HARDMAN, STATE CONSERVATIONIST, UNITED STATES SOIL CONSERVATION SERVICE

Mr. HARDMAN. I am George Hardman, State Conservationist on Soil Conservation Service, State of Nevada, office in Reno. I will say in the beginning that the Soil Conservation Service operates a somewhat cooperating agency. A very definite limitation is placed upon the service in its operations. First, it operates through and with the soil-conservation districts. There is very little independent operation outside the soil-conservation districts. It so happens that this territory, practically all of Clark and Lincoln Counties and all of Nye County are covered in the soil-conservation districts. The second limitation under which we work applies to federally owned and privately owned land. By the terms of reorganization No. 4 of 1951, I believe the name of it was, the Soil Conservation Service was removed from operation on Federal lands. Our only operations that are on Federal land now are those that are carried on in cooperation with the Federal agency, and has restrictions and then only under certain conditions. That does limit our operation considerably. Where the majority of the lands in the area are Federal, we are pretty well out of the picture. Where the majority of the lands are private we can work in the area, and cover all lands because it becomes too expensive to separate the lands, so we cover all of them. That limits our work in this area considerably to the Las Vegas Valley, Pahrump Valley, the Mesquite Valley, and a few other areas. We have, of course, the possibility of working with any agency, the Bureau of Reclamation for instance. We have worked with the Bureau to a considerable extent, to carry on most any kind of an investigation or survey in which they are engaged or interested. That isn't necessarily the case. I don't know that there is anything further, Senator, that I can say on that.

Senator MALONE. Well, I want to ask you, George, what the procedure is in order to go ahead and make such a survey and what the results would be. But first I am interested in your limitations. I am not entirely familiar with how you are limited on those items. What about working with the State engineer of this State? I mean if he called upon you to help investigate an area or cooperate with him to help investigate an area covered by the proposed legislation for an irrigation project?

Mr. HARDMAN. Again, if the agency which has jurisdiction wishes to cooperate or wishes us to cooperate we do enter into such cooperation and have on some occasions and have assisted in making surveys and making recommendations.

Senator MALONE. Suppose the State engineer—you heard Hugh Shamberger's testimony, stating that he is ready, willing, and anxious to start such an investigation—suppose he called upon you personally for such cooperation, what would be the procedure in that case?

Mr. HARDMAN. Well, I would take that request to my immediate superior and ask permission to enter into cooperation with him. If another agency, like the Bureau of Land Management, which has the first jurisdictions over the lands, if they wish to enter into that cooperation, I think we would probably be in a position to do so. The important thing is we would probably call upon the Bureau of Reclamation to cooperate.

Senator MALONE. Yes; I am coming to that, I have discussed it with Mr. Neilson. What I am trying to determine now for the benefit of the record is what is the means of arriving at a situation where all agencies could assist in the work, if there are certain technical limitations you would in some way have to overcome. Who is your immediate superior, and where is he located?

Mr. HARDMAN. Mr. J. H. Crist at Portland, Oreg.

Senator MALONE. What region is he in?

Mr. HARDMAN. He is in region 7 of the Soil Conservation Service.

Senator MALONE. That includes what areas?

Mr. HARDMAN. The States of Nevada, California, Oregon, Washington.

Senator MALONE. That seems to be a very important area. Now, I just want to settle this a little further before we bring the Bureau into it because the Bureau, Mr. Neilsen has testified—and I see that it is true because when I was State engineer we used to cooperate with the USGS in many ways; that was a cooperative thing on a mandatory basis. When you talk about the investigation of two hundred, two hundred and thirty, or two hundred and forty thousand acres of land it is no small job, and it wasn't contemplated by the legislature when they set their policy. There is no indication then that if the State engineer requested you officially, or the Colorado River Commission or some State agency, which would include our State engineer, of course, requested you to cooperate with them using your organization to the best of your ability, if you then communicated with your immediate superior in Portland and his decision was that it would be at your option to be cooperative in such a survey, what then would be your procedure?

Mr. HARDMAN. I suppose the next thing would be to get the agencies that were interested together and set up some kind of a program.

Senator MALONE. Which would usually be the Bureau of Land Management, the State engineer, the Colorado River Commission, and the Bureau of Reclamation if they were interested. What are your mandatory limitations? In other words, it isn't necessary for the State engineer to——

Mr. HARDMAN. We have no requirements for cooperation, if they are not on Government lands.

Senator MALONE. Well, if these operations are on Government lands, which they are largely, of course, or the Muddy River, Paradise Valley and other localities which would be included in the area of Colorado River water source, in order for you to be turned loose so that you could cooperate in such a survey, from where would that authority have to come?

Mr. HARDMAN. Well, it might have to go all the way back to the Secretary of the Interior.

Senator MALONE. Is your Soil Conservation Service a part of the Interior?

Mr. HARDMAN. No, it is in the Department of Agriculture, but the lands that we are barred from operation are under the jurisdiction of the Interior Department.

Senator MALONE. Now what would be necessary? Suppose the Bureau of Land Management and the Bureau of Reclamation, represented by Mr. Neilsen, whom I have no doubt is willing to cooperate, it then becomes a question of procedure so everyone is in the clear and everyone understands what he can do. Congress creates all of these organizations and whatever the committee determines it would like for you to do, then it would be a question of how to operate under those orders. If the Secretary of the Interior requests the Bureau of Land Management to cooperate with such a survey and requests the Bureau to go ahead with their survey, which, as Mr. Neilsen indicated, might have to be independent on account of the necessity of the cooperating agency putting up certain funds, they might have to conduct an independent survey. But if the necessary permission were granted, there would really be no reason why all of these agencies couldn't meet and determine a procedure that would n't overlap.

Mr. HARDMAN. I don't think there is any question but what that can be done. Of course, we would not wish to enter into work on the public lands that did not include a complete agreement on the type of survey, the standards and so on that are necessary.

Senator MALONE. And the understanding as to what you would do that would fit into their survey. All right; with that understanding, then, you yourself are ready to proceed immediately.

Mr. HARDMAN. As I say, we have this area in Clark County covered by a soil conservation district now, and we intend to begin operations on some of the private land almost immediately; that is, in the next month or so. Those areas in the Las Vegas Valley and so on which we need to cover will probably be covered this winter.

Senator MALONE. Does that include the area of Las Vegas, Wash. and the Muddy River?

Mr. HARDMAN. Any area that is requested.

Senator MALONE. From whom do you have to receive this request?

Mr. HARDMAN. The soil conservation district with their supervisors are the initial cooperating agencies.

Senator MALONE. And you say that practically all of this area is organized?

Mr. HARDMAN. That is right.

Senator MALONE. Muddy River is organized?

Mr. HARDMAN. That is right.

Senator MALONE. Is there any organization that takes in these areas that happen to be under cultivation in Clark County proper, central Clark County?

Mr. HARDMAN. Yes, it is all in this new district, the Las Vegas Valley district.

Senator MALONE. I mean would it include these public lands which you could not operate on without special permission, but it does include them, so you have nothing further to do as far as organization

is concerned, except to arrive at an understanding. You yourself are willing to start immediately with such understandings, and work. I think that clears that up, George. I knew that would be your attitude. You and I have discussed this over a period of 30 years, especially when I was State engineer. Remember, you made the soil surveys in the Walker River area when we were talking about drainage and further water storage there. I guess this was as early as the early 1920's; wasn't it?

Mr. HARDMAN. Yes, beginning in 1920, ending up in about 1933.

Senator MALONE. Will you then give us some idea, so that the committee will have some idea, what would be your procedure if you were told tomorrow to start a land classification and soil survey to determine the availability of the areas included in the six irrigation bills with which I know you are entirely familiar, to determine the availability for irrigation and crops, the types of crops and so on, what would be your procedure if you were to start tomorrow?

Mr. HARDMAN. First we would procure the aerial surveys for the area.

Senator MALONE. Are these surveys made already or would you have to do that?

Mr. HARDMAN. The plans have already been made and are available for purchase from the United States Geological Survey.

Senator MALONE. And they are very inexpensive?

Mr. HARDMAN. They are not very expensive because they speed up the operations of a survey tremendously. Then after we secure the necessary aerial pictures that cover the area under survey, we go into the territory, we would take most of the surveys to begin with on a reconnaissance basis, because as we get into the territory we find out what we have there. As explained by Mr. Neilson the other day, there are a number of things you look for in a survey. The lay of the land, topography, roughness of the surface, the general slope, and the first breakdown would probably be on a basis of the slope factor. You consider the texture of the soil, and then you begin to look for breaks in the land that are visible to the survey. Then you begin to draw lines on the various types of land based on those several factors. The question of alkalinity of the land is considered, and necessary tests are made and the survey progresses. Before the survey would be completed, there would be some question of outlets for surface water to be considered, drainage——

Senator MALONE. Some drainage procedure engineers found necessary, something they didn't know in the beginning when the Bureau of Reclamation was first organized in 1903, when even the engineers thought the only problem was to get the water on the land. They soon found out that we had a problem of getting the water off the land, or else it would concentrate the alkalinity and salinity until it would finally retard or destroy agriculture.

Mr. HARDMAN. That is exactly true, and that is the reason why we generally look to outlets, the possibility of outlets in some of the interior areas. The exterior outlets do not exist and you have to look for some way of disposing of the water through natural means—evaporation and so on. The classification that we would make on a basis of capability looks to the ultimate usefulness of the land and how it can be used and preserved. We have different objectives from

what the Bureau of Reclamation has in their first surveys. However, it is my observation in studying a great many of these surveys that there is no great difference in the final objective and no great change need be made in a joint survey to serve both agencies.

Senator MALONE. Well, Mr. Hardman, the vital objective, at least from my standpoint, would be, after 30 years in the business, what you want to know first is the expense, and some detail as to estimated costs of the various features. What you want to know is what will it cost to get the water on the lands, so a man can open an irrigation ditch and irrigate a piece of land. Roughly, what it would cost to prepare the land. Your ditch system, your pumping system, in this case it would all be under a pumping system, all the way from 25 to 30 feet up to 800, 850 feet, that to be determined in detail, but that all of those things are very simple to determine. We want to know, in each particular project, what the pumping plant would cost, what the ditch system would cost, what it would cost to prepare the land to receive the water. In other words, arriving at an overall cost.

You can't take one feature and say this is going to be the cost until you know all of it, because there is only one source for the money and that is the return from the crop.

You have heard me talk about subsistence homesteads. Personally, I am not interested in 300- or 400-acre farms that raise wheat, cotton, or corn. I am interested in looking forward, and this is where we tie into the power requirements in the industrial area. I am interested in looking forward to 10,000 or 15,000 employees around the area instead of the 2,600 that we have now had. Probably a quarter or a third of these people would rather live on half an acre or an acre or 5 acres or 10 acres, doing the reclamation work themselves, than to live in a home where they have only a 5,000 square foot lot. On a few acres they can raise their potatoes, carrots, lettuce, cabbage, and a couple of apple trees and have a storage cellar where a man can exist a few months without a job and yet have something to do. I know of many people who want such a piece of land. So, in this area, watching the growth, you can take a car anywhere in a couple of hours and see thousands of people who have come in here since you are I came into the area in 1927 when I was State engineer and Colorado River commissioner. There was nothing in the area then—nothing whatever. Now, if we prepare the investment plan, meaning if you have the power, and you now have the industrial power, and you have domestic water available, and you have the water available for these subsistence homesteads. Many of these people who are living in concentrated areas will want to get away—5, 10, or 15 miles away from town and factories and have something to do. I know they do from my own experience and I know you do. So, that is my objective I am only talking for one member of the committee, to make a good employment climate in the area that is favorable to industry My experience in industrial engineering shows me, has always shown to me, that you don't have to go find these people to come in; they will find you. If the conditions surrounding the industrial area are favorable, you can't keep them out. That was shown here when we first had this two-mill power to withdraw from Hoover power plant. You are familiar with the fact that 90 percent of our own people living in the area, didn't think we would ever use any power. One of the biggest fights I had

at that time was with our own people and, of course, with the States of Arizona and California and others that wanted all the power. Now we have established that favorable industrial plan in the availability of two-mill power. Now we have used up all this power; it is all contracted for, and we are looking for more power at a price that can be used. All we have to do, in my humble opinion, is to get this power, then the demand will be there for the land that we are trying to open up as an auxiliary project and make it sound. It will create satisfied people who are working at the plant. They will own a little piece of land; they will have their roots started. There are so many new people coming in and the children are growing up, we must make a place for all these people. That is my objective, and I know it is yours. We have reached a point where we have to proceed to that objective. We want estimates of costs of each one of these things; we want to know the suitability of this soil for crops, and what kind of crops. Also, the progress that has been made with agriculture in this part of the country in your department and others. Probably only a small amount of the land in Clark County is unavailable for agriculture of some kind if water, fertilizers, and soil conditioners are applied. I am fully aware that that can't be done commercially on a 500-acre piece of land for crops, but on a 10-acre farm or an acre where a man does most of his own work, it can be done. Do you agree with that?

Mr. HARDMAN. I think that is right.

Senator MALONE. In other words, it is silly to say that this land is not available for irrigation.

Mr. HARDMAN. As far as the quality of the land is concerned, I think that is right, because in small areas you can almost make the land what you want.

Senator MALONE. In your soil conservation, your soil surveys, that is what I am interested in for the record, it is to have you describe what part of this work you are going to do as with your associates and the number there are likely to be that make this information available to the committee that is likely to recommend these projects to the Members of Congress who will study them, and to the Bureau of Reclamation, who in the last analysis will install the pumping plants and prepare the acreage, just as they are doing at Grand Coulee.

Mr. HARDMAN. We are best equipped, Senator, to help determine the quality of the land and what can be done with that land. I think to some extent we may help to determine what it may cost to put the land into use. Our particular job is in working with individual pieces of ground and helping the farmer in developing his own program on his farm.

Senator MALONE. Then, once these people begin to come in, your work would be cut out for you.

Mr. HARDMAN. Yes; we immediately begin to operate with the individual farmer. On a project basis we wouldn't think we were equipped without building up an organization to go into such things as determining the cost of providing water to land.

Senator MALONE. I wouldn't think that would be necessary. In other words, the State engineer, the Bureau of Reclamation, the Bureau of Land Management, and your service at the present time have all the personnel necessary to do what you are directed.

Mr. HARDMAN. That is right.

Senator MALONE. I haven't found anyone in Clark County who now has no land that doesn't want to own a piece. Everybody wants a piece of land. I want one myself. It is only a question of making it available, and the land is here. Of course, we look forward to doing this under the Bureau of Reclamation Act where it is done on a 40- or 50-year period, where the expenditure is made during a 50-year period with no interest payments. That is being done all over the 17 Western States. As I said before, I am not talking about a wheat farm where a man has to hire to have his work done and where the expense would be prohibitive, but I am talking about a small area where the owner alone can take care of it. If it were on a base cost of $200 or $250 or $500 an acre over a period of 50 years, it would only be about $5 an acre a year with no interest. We are talking about something that we know about, and we know it is feasible and we know that the people who are already in this area want it.

Mr. HARDMAN. In these small individual areas, we will go in and lay out a program that includes all the operation that is necessary. How to level the land, how to ditch it, what fertilizer may be needed to bring it into production, and general advice of that kind. That would be after these have been started.

Senator MALONE. Right now, you are an agency to determine the texture of the soil in cooperation with the Bureau of Reclamation and others and to fill in some of the work they to.

Mr. HARDMAN. I think the way we could best express that is that we could probably supplement their efforts, because our people are particularly experienced in this type of territory and they are continually at work at this job. They are continually in an operation of that kind. I think we could help considerably. So far as the cost of the matter is concerned, I don't think that woold concern us very greatly if this overall program were carried on over several years, for the reason that we have a crew in here to carry on the private-land work. We can often do some of the other work at very little additional cost. The second factor that influences our operation is a matter of training. We are continuously training new groups of men, and when they are being trained it doesn't make too much difference what piece of ground they are working on. The cost of training is already in there. We will continuously have those types of crews in this territory.

Senator MALONE. Tell me more about these soil-conservation districts, how they are set up.

Mr. HARDMAN. Each conservation district is set up under State law by the farmers in the territory. Any area that wishes to can petition the State soil-conservation committee, which is set up under the same law, to organize a soil-conservation district. The State soil-conservation committee then proceeds to take the necessary steps to create a district, leading to a referendum to the people in the territory proposed by the district. If that referendum is favorable and other things look like a district should be created, in the judgment of the committee, they then proceed to declare a district ordinance. It is operated by a board of supervisors elected by the farmers in the territory.

Senator MALONE. Do they assess themselves for funds for work that their board desires to do?

at that time was with our own people and, of course, with the States of Arizona and California and others that wanted all the power. Now we have established that favorable industrial plan in the availability of two-mill power. Now we have used up all this power; it is all contracted for, and we are looking for more power at a price that can be used. All we have to do, in my humble opinion, is to get this power, then the demand will be there for the land that we are trying to open up as an auxiliary project and make it sound. It will create satisfied people who are working at the plant. They will own a little piece of land; they will have their roots started. There are so many new people coming in and the children are growing up, we must make a place for all these people. That is my objective, and I know it is yours. We have reached a point where we have to proceed to that objective. We want estimates of costs of each one of these things; we want to know the suitability of this soil for crops, and what kind of crops. Also, the progress that has been made with agriculture in this part of the country in your department and others. Probably only a small amount of the land in Clark County is unavailable for agriculture of some kind if water, fertilizers, and soil conditioners are applied. I am fully aware that that can't be done commercially on a 500-acre piece of land for crops, but on a 10-acre farm or an acre where a man does most of his own work, it can be done. Do you agree with that?

Mr. HARDMAN. I think that is right.

Senator MALONE. In other words, it is silly to say that this land is not available for irrigation.

Mr. HARDMAN. As far as the quality of the land is concerned, I think that is right, because in small areas you can almost make the land what you want.

Senator MALONE. In your soil conservation, your soil surveys, that is what I am interested in for the record, it is to have you describe what part of this work you are going to do as with your associates and the number there are likely to be that make this information available to the committee that is likely to recommend these projects to the Members of Congress who will study them, and to the Bureau of Reclamation, who in the last analysis will install the pumping plants and prepare the acreage, just as they are doing at Grand Coulee.

Mr. HARDMAN. We are best equipped, Senator, to help determine the quality of the land and what can be done with that land. I think to some extent we may help to determine what it may cost to put the land into use. Our particular job is in working with individual pieces of ground and helping the farmer in developing his own program on his farm.

Senator MALONE. Then, once these people begin to come in, your work would be cut out for you.

Mr. HARDMAN. Yes; we immediately begin to operate with the individual farmer. On a project basis we wouldn't think we were equipped without building up an organization to go into such things as determining the cost of providing water to land.

Senator MALONE. I wouldn't think that would be necessary. In other words, the State engineer, the Bureau of Reclamation, the Bureau of Land Management, and your service at the present time have all the personnel necessary to do what you are directed.

Mr. HARDMAN. That is right.

Senator MALONE. I haven't found anyone in Clark County who now has no land that doesn't want to own a piece. Everybody wants a piece of land. I want one myself. It is only a question of making it available, and the land is here. Of course, we look forward to doing this under the Bureau of Reclamation Act where it is done on a 40- or 50-year period, where the expenditure is made during a 50-year period with no interest payments. That is being done all over the 17 Western States. As I said before, I am not talking about a wheat farm where a man has to hire to have his work done and where the expense would be prohibitive, but I am talking about a small area where the owner alone can take care of it. If it were on a base cost of $200 or $250 or $500 an acre over a period of 50 years, it would only be about $5 an acre a year with no interest. We are talking about something that we know about, and we know it is feasible and we know that the people who are already in this area want it.

Mr. HARDMAN. In these small individual areas, we will go in and lay out a program that includes all the operation that is necessary. How to level the land, how to ditch it, what fertilizer may be needed to bring it into production, and general advice of that kind. That would be after these have been started.

Senator MALONE. Right now, you are an agency to determine the texture of the soil in cooperation with the Bureau of Reclamation and others and to fill in some of the work they to.

Mr. HARDMAN. I think the way we could best express that is that we could probably supplement their efforts, because our people are particularly experienced in this type of territory and they are continually at work at this job. They are continually in an operation of that kind. I think we could help considerably. So far as the cost of the matter is concerned, I don't think that woold concern us very greatly if this overall program were carried on over several years, for the reason that we have a crew in here to carry on the private-land work. We can often do some of the other work at very little additional cost. The second factor that influences our operation is a matter of training. We are continuously training new groups of men, and when they are being trained it doesn't make too much difference what piece of ground they are working on. The cost of training is already in there. We will continuously have those types of crews in this territory.

Senator MALONE. Tell me more about these soil-conservation districts, how they are set up.

Mr. HARDMAN. Each conservation district is set up under State law by the farmers in the territory. Any area that wishes to can petition the State soil-conservation committee, which is set up under the same law, to organize a soil-conservation district. The State soil-conservation committee then proceeds to take the necessary steps to create a district, leading to a referendum to the people in the territory proposed by the district. If that referendum is favorable and other things look like a district should be created, in the judgment of the committee, they then proceed to declare a district ordinance. It is operated by a board of supervisors elected by the farmers in the territory.

Senator MALONE. Do they assess themselves for funds for work that their board desires to do?

Mr. HARDMAN. They have no power of taxation; they can only get money that may be granted to them, or they may earn in some way—voluntary contributions. It is a voluntary organization throughout.

Senator MALONE. It does have sanction through this State organization? It has some features of the irrigation-district law and the power-district law minus the ability to assess.

Mr. HARDMAN. It has some of those. It has wide powers, but no money. Our operations are limited because the funds are originally granted by Congress principally, not entirely, but principally in cooperation with the districts.

Senator MALONE. You do believe then that your work here would be mostly to determine the soil texture and the crops to which the soil would be suitable and the possible improvements of that soil, pointing out the improvements that would make it available. You are willing to put this work into motion at the earliest possible time your superiors will permit. And you are ready to cooperate with the Bureau of Reclamation, the Bureau of Land Management, the State Engineer, the Colorado River Commission, and any other agency that could properly enter into the work.

Mr. HARDMAN. That is right. We are already carrying on, or have set up the basis for a program under the private land justified. We have completed the Pahrump Valley and will complete the Muddy River in cooperation with the Bureau of Land Management and their survey section.

Senator MALONE. Your only limitation here in proceeding as you have been doing over the past 25 or 30 years is a matter that it is Government land; therefore, you must have that additional agreement in order to proceed.

Mr. HARDMAN. That is right. We have the people and we have the money.

Senator MALONE. I think that is all, George, unless you have some further statement to make.

Mr. HARDMAN. I have no other statement, Senator, although there is one more thing that comes into this planning. We are associated with the Farmers' Home Administration and do most of their engineering and actual work on the ground. I would like to say that the Farmers' Home Administration is handicapped by having too tight a limitation on their process.

Senator MALONE. What is this Farmers' Home Administration?

Mr. HARDMAN. That is the branch that takes care of the water-facilities program and makes direct loans to farmers for improvements and so on. They have a $100,000 limitation on a single project at the present time. This is, in this territory, too low.

Senator MALONE. That is a matter we can take up at some future time. Perhaps that would come anyway when the land is available and the actual people who are interested in the land begin to develop it.

Mr. HARDMAN. That is right. We have some of those things working now.

Senator MALONE. That is fine, George. Thank you very much.

Mr. HARDMAN. I am glad to have been here.

Senator MALONE. Mr. Nielsen, I know you are a busy man. Would you like to make any further statement in regard to the land classifica-

tion and the possible soil surveys in this area? Mr. Nielsen has already testified; so there is no reason for any further identification. He has the entire charge of the Bureau of Reclamation work in this district, and would be in charge, without doubt, of any further work that is allocated to the district.

STATEMENT OF E. G. NIELSEN, DIRECTOR, REGION 3, UNITED STATES BUREAU OF RECLAMATION

Mr. NIELSEN. I have only one thing that I would like to make clear to the committee. Our investigational activities do extend to the classification of lands, prior to the submission of a report on an irrigation district. We are equipped to make land-classification surveys where the cause is justified. The land-classification process and the results that grow out of the land-classification process are part of our whole economic valuation of any proposed project. Now, why we would go to an outside agency to do that work when we are equipped to do it, I am at a little loss there. However, if you have in mind a land classification and want a land classification definitely, you might call on an outside agency, because we would first, before getting into a land classification, have to examine the whole irrigation potentiality and be satisfied that money could well be spent in a land classification. To say roughly, we would, early in the stages of investigation, determine whether or not the potentiality could pay its operation and maintenance costs. If it couldn't pay its operation and maintenance costs, we wouldn't go to a land classification.

Senator MALONE. Let's explore that just a little further. You have heard what some of us have in mind. We do not have in mind 150-acre farms or 400-acre farms or large farming operations. What we have in mind here is small acreage developments, and I personally believe that the land value for that would be enormous. I anticipate that power and water can be made available to this area to follow through to double or triple the population in this area, without any question. I base that simply on long experience as to what it means when you put a man to work—what happens. There is no necessity for me to go into that again now, because it is all well known. It is right here under your eyes where there were 4,000 people in 1927 in the entire area and none of them making any money, all waiting for the Boulder Dam. I have scars all over me from that operation and mostly from the people of the area, because I demanded the power and demanded revenue and all the conditions necessary to going ahead. I wrote briefs during that time that would make good reading now, showing that all this could be done. You will find a report published when a Mr. A. M. "Tom" Smith took over the State engineer's office. He was working with me during the last few years when I was there, and you have maps made then, not within the last 10 days or the last 6 months or 6 years but made in 1927 to 1935. We talked about subsistence homesteads when and if this industrial center is created, and we knew it would be created if we could get the power at a cost at which it could be used. Since that time, if you will read some of those briefs, it sort of made a prophet out of me. I said that we could use and would use 180,000 horsepower in this area within 20 years if it were available at a low enough price. We are using nearly that

much, and the demand exceeds that at the present time and it has been for about 20 years. I also said that demand for land would be there, and it is here now. I say now that if we can get this additional power, which I know we can get and we have started it—we have started it now with a definite contract for 33,000 kilowatts from Shasta, which ought to satisfy anybody that the precedent has been set—we can build these dams that we have talked about here during the last 2 days, Bridge and Glen Canyons, and throw in about 1,300,000 kilowatts of additional power into the Southwest, a reasonable share of which would stop here if the demand were here, two or three hundred kilowatts at least. There is roughly 700,000 kilowatts at Bridge and 800,000 at Glen Canyon. Then you are creating the investment climate that is necessary for the next step. Now, when you say that you would determine whether the operation would be successful, whose judgment is that?

Mr. NIELSEN. The combined judgments of our engineers based on our reconnaissance.

Senator MALONE. Well, it has not been very good up to date. If at one time it had been discarded as not suitable, what factors would you now take into consideration with what you now know?

Mr. NIELSEN. Shall we talk about the Las Vegas area directly?

Senator MALONE. Yes.

Mr. NIELSEN. As a matter of fact, we had intended to go back into the Las Vegas area to get back into Bureau studies which were made in 1935, as to how best to get water there and as to the payment potentiality of the land. Now, talking about subsistence homesteads, what are the new aspects?

Senator MALONE. Well, so far as I am concerned, I never talked about anything else even 10 years before your report was made.

Mr. NIELSEN. That would bring the matter of small homesteads in with the payment of costs very substantially. It would become a semi-urban, I would think, with the ability to pay a great deal more for water than you could pay for just general food costs. We would take that into consideration. On the basis of that first look, it did seem as though we could at least get operation and maintenance costs refunded for the project. One of our early moves would be a detailed land classification, just as we did in the Moapa Valley.

Senator MALONE. How long would this first operation take?

Mr. NIELSEN. Well, Mr. Larson has already gotten into that. How far have you gotten into the very preliminary steps of looking into this Las Vegas area?

Senator MALONE. I believe I would like to hear Mr. Larson in connection with this so if you have anything further you may proceed.

Mr. NIELSEN. I would like to make clear that the land classification is just part and parcel of our whole investigation.

Senator MALONE. Here is the thing that perturbed me considerably. I read the reports of the Bureau of Reclamation, you are pumping water up a thousand-foot lift, I talk about this as something that is necessary for this area and also bringing in again to bring to the attention of the committee that there is a certain amount of water in the lower basin States. There are only two ways you can appropriate water, one in the western States is to put it to beneficial use. There are two ways, by appropriation and use and the other way is through

interstate agreements. There has been no interstate agreements on the division of water in the lower basin. I can't emphasize that fact too emphatically. And there is no certain amount that California is entitled to, there is no certain amount of water that Arizona is entitled to. There is no certain amount of water that we in Nevada are entitled to except on a matter of equity. There are two other States interested in this water. They are Utah and New Mexico to the extent that they are in the lower basin. I am getting so tired of hearing about 300,000 acre-feet to Nevada, 2,800,000 acre-feet to Arizona, and then asking for a million more which would make 3,800,000 acre-feet, California 4½ to 5 million acre-feet and then to see the smokescreen drawn up again that the great national boundary between Arizona and California as to who is going to get this extra million acre-feet, obscuring Nevada entirely. I must say that the Bureau of Reclamation has sort of fallen in with that smokescreen. I know it so well it scares me to death, as representing this little State of Nevada, that if that water goes out of the basin or into another State, we will be lucky to get any additional water because it simply will not be in the basin. You are familiar with the fact that in 1928, I had submitted the only comprehensive report. I didn't do it all by myself. There were 6 or 7 State engineers who worked on it. That report was finally printed as Senate Document 186. The report shows, without a doubt, that there will be very much of a limit on water in the lower basin States. There is 8½ million acre-feet, with three-fourths of a million acre-feet being the very maximum that was ever used by Mexico, yet the upper basin States, Arizona and New Mexico, came into this picture and agreed to give Mexico a million and a half acre-feet of water, which made the lower basin States three-quarters of a million acre-feet short of water. The people responsible for that, I know who they were and why; I could be arrested if I said what I thought of them if I said it on the Senate floor. I don't want those things to continue. On a matter of equity, we are now getting about 75,000 acre-feet of water, probably less than that. There is 2 million acre-feet going to Arizona. I care nothing about the controversy. I know where the water is going. My report at that time showed it and so does the Colorado River Commission contract. Four and a half to five million to California. God bless both of those States. I am not against them; I am merely for this poor little State of ours.

We are piling up people working here in congested areas with no chance to have any kind of an irrigated area. I am also interested in the water table dropping here 2 feet a year. In 10 years that is 20 feet extra, in 15 or 20 years it probably will mean an uneconomic lift for pure drinking water, and for sewage disposal. You have stopped your work and investigations in this area, in Las Vegas, Whitney, Pittman, Boulder City, and the whole surrounding country. I have listened to debates on how bad the other States need the water, they couldn't possibly need it any worse than we do. You see, I am counting on being there to supervise this thing, we will find out a little later whether I am right or not. But if I am, we certainly are going to concentrate our attention on this area if I have anything to do with it. It is not going to be somebody who comes out here in the heat of the summer and says it is no fit place to live anyway, we will put this water someplace else, and it is not suitable for irrigation here. That is about what your Department said.

Mr. NIELSEN. Well Senator, you can have your own opinion on that.

Senator MALONE. I do have my opinion on it.

Mr. NIELSEN. I want to be sure that you know what we are doing in Nevada.

Senator MALONE. I would like to know.

Mr. NIELSEN. We have completed the survey on the Moapa Valley irrigation potentiality, which except for some refinement in the report language, is complete. In the case of Moapa Valley, they can pay their operation and maintenance costs and could repay its capital cost in about 100 years. That is the Muddy River Irrigation Co. plus the Indian reservation. You will remember the touchy problem in waterrights up there which Moapa Valley project would clear up. We are pretty well advanced on the Mohave project. I would say we have our answer subject to review by the Chief Engineer and the Commissioner on the Mohave pumping project which is in the very southernmost tip of Nevada.

Senator MALONE. How many acres is that?

Mr. NIELSEN. About 1,600 acres.

Senator MALONE. That has already been investigated and pronounced feasible?

Mr. NIELSEN. Yes, that could be said. The question is, how best to handle it. Whether to handle it under the reclamation program or to handle it by a private enterprise better gated to that small a development.

Senator MALONE. In any case, if it were handled by the Bureau of Reclamation here it would be on the customary procedure of a certain amortization period without interest.

Mr. NIELSEN. That is right.

Senator MALONE. What would be the customary period that could be recommended in this area? Maybe not customary, but the period to which it would adapt itself?

Mr. NIELSEN. Senator, I think we are going through a shifting philosophy on that, as you know the Secretary is permitted by law to authorize automatically, a project which can repay its costs in 40 years. And there is an ability on his part to pronounce or to allow a 10-year development period in addition to that 40 years, without paying for the capital cost at all.

Senator MALONE. So what you would do, suppose 1 of these projects under the 6 irrigation bills, which I have introduced in the Senate were to be pronounced feasible under the conditions of the land classifications that were made and the estimated costs, then he could take the first 10 years as a development period and then during the next 40 years the total cost would be amortized, payments without interest.

Mr. NIELSEN. With 1 slight change, during that 10 year development period the irrigators must pay their operation and maintenance costs.

Senator MALONE. That is correct, however, the basic costs would be amortized in the last 40 years, without interest. Then they are, presumedly, the first 10 years developing their land, getting it ready, even if it were developed and they were utilizing the water for part of that 10 years, there would only be the operation and maintenance until the 11th year.

Mr. NIELSEN. That is right.

Senator MALONE. That is very good and it is exactly what I had in mind that you would carry out. Now if there were to be any further extension of that time, say 60 years or 70 years, that would require a special act of Congress.

Mr. NIELSEN. That is right. The Reclamation Act as it is now written requires that we report not only on those that can repay in 40 years, but to report on the potential as we see it, leaving to Congress the judgment of whether 40, 50, 60 or 70 years represents a reasonable repayment period.

Senator MALONE. Naturally Congress, being the agency that established the first period, could change it any way they see fit.

Mr. NIELSEN. Yes; as a matter of fact, the law doesn't say anything as to any certain period of years, except to say that the Secretary may declare a project to be authorized automatically if it can qualify in 40 years.

Senator MALONE. It needs no further legislation after that.

Mr. NIELSEN. It needs no further legislation, it needs only appropriations.

Senator MALONE. You do keep Congress advised of what you are going to do and do not exercise that authority, although you have it.

Mr. NIELSEN. I don't remember an instance where we have used it.

Senator MALONE. I think that is correct, and highly proper, because Congress is intensively interested in what you are doing and there is a reason for that in this area. We do not want you to do anything that in any way would jeopardize your standing with the States that happen to be outside of the 17 Western States that benefit from the Reclamation Act. In line with the repayments, what is the longest period now on record, whether it is a special act of Congress or whatever, that has been allowed for repayment?

Mr. NIELSEN. I think that 68 years is the longest—could you check me on that, Vod?—68 years is the longest repayment contract we have

Mr. LARSON. I couldn't say for sure what the longest one is.

Senator MALONE. Subject to check, if you find different you can submit it to the record.

Mr. NIELSEN. In addition, we have programed, you understand, each year for our own purpose and for the purpose of informing Congress of our activity, each year we submit a 6-year plan of continuing our program on the part of the Reclamation Bureau. In this area, we have programs beginning with the fiscal year of 1955, which is a year from next July 1. We have in mind a review of curves, the 1936 report on the Las Vegas pumping project. That is already in the mill. In other words, we have been working in Nevada with the idea of picking off one by one the potentialities and we pick the one with the most practical potentiality first. That seemed to be Moapa Valley. I think our only reason for doing Mohave Valley next was——

Senator MALONE. Then you do have a general policy, that what you do when you examine these areas you do it under existing conditions. When those conditions change you proceed on a reexamination.

Mr. NIELSEN. That is correct, our program isn't necessarily static. Our commitment, we have pretty much of a commitment to follow through with that which we told Congress we were going to do with

the funds they made available to us this year. Harvey McPhail explained that.

Senator MALONE. How long have you been with the Bureau?

Mr. NIELSEN. 18½ years.

Senator MALONE. During that 18½ years, I have been familiar with your work, but during the period of 18 years, or during the period of 33 years, we have seen profound change in what we call the feasibility factor when $25 to $40 an acre might have been quite a large development cost in 1920 following World War I, when I became active in private engineering following that war. Now that same situation might justify $150 to $200 an acre; is that true?

Mr. NIELSEN. Yes.

Senator MALONE. In other words, a great change in conditions. So we can easily see when a member of the Bureau made this reconnaissance here with nobody working at the plant and no thought that anyone ever would, there was an entirely different situation now with 3,000 men employed in the area and the possibility that it might rise to 10,000, that is an entirely different situation.

Mr. NIELSEN. That is right. Our reason for rescheduling the Las Vegas area was the critical water shortage in the area, expecting that as you get to the municipal waterload to tie down to the pipeline or the pumping facilities, we would only take a portion of the cost. That was the reason we have the Las Vegas pumping project up for reanalysis and bring in the element of subsistence homesteads.

Senator MALONE. That is true. For example, in the lower Humboldt area in 1925, before I became State engineer, I made additional surveys there on what is now Rye Patch Dam, on a feasibility basis; that is all history now. Your people moved in at our invitation and got the money to build it, and now it has made one of the most prosperous valleys in the State of Nevada, if not in the United States. When we first added up the estimates in the valley to repay the money we were right on the ragged edge, so we went to the townspeople—there were about 600 or 800 people who owned property there. This property is very valuable now; it would have been worth nothing without the water, so they were willing to have their lots, little 50- by 500-foot lots, put in and assessed according to needs. It wasn't a matter of the amount of money we collected from the lots that counted—that was nominal, maybe a dollar or two a year on a lot, on the same basis that you assess property, but the fact that the value of the town itself was behind the bond issue. I don't suggest this here, you understand, but here is a city with maybe 30,000 people, I don't know how many there are now, but there are certainly 45,000 in the area, where there were only 2,500 in 1927 when I came down here. So the minute you construct a pumping plant for an irrigation project for a certain number of thousand acres in this area, if they want to come in on that deal then their domestic-water problem is solved, isn't it?

Mr. NIELSEN. We would certainly think that would be most attractive to them and most attractive to us.

Senator MALONE. That is right. Now, you have Henderson, you have Pittman, you have North Las Vegas, you have this whole area, and they could get water cheaper than they could otherwise get it, and the irrigation cost factor would be cut down, and besides that, in guaranteeing them repayment cost to the Federal Government, it

would be adding assessable property in the deal. I am not suggesting that that be done, but it is available.

Mr. NIELSEN. We would expect the communities to contract for water.

Senator MALONE. In other words, instead of going in alone and bonding the city several million dollars——

Mr. NIELSEN. We wouldn't be bonding it.

Senator MALONE. You wouldn't be bonding it all, but you would have your assets behind the deal. In other words, the market for water is there and if you get the money out of the water for domestic purposes, it could be at a much higher price than you get for irrigation. Then if you are talking about a kind of feasibility that probably in 1927 would have been unheard of.

Mr. NIELSEN. The Las Vegas participation in this seems to be something like a revenue bonding process, except that we would not be selling bonds; they would be lending their credit to the United States.

Senator MALONE. But you could buy the water.

Mr. NIELSEN. That is right, out of revenues. As for the irrigators, we do not want to touch their lands; we simply hope that they will buy the commodity we have to sell.

Senator MALONE. My only point in this subsistence homesteading basis is where a man working down at the plant here can keep his job and have an acre or 5 or 10 acres for his family; do a large amount of the development work himself. Even if it cost a thousand dollars an acre for repayment, if he has 50 years to repay it he will do it. I think we could get such terms without any difficulty if it were necessary, in addition to the development period. He is getting his payment, his total payments for his 5 acres to a point where it would be less than rent anyplace else for a living, $100 a year over a period of 50 years, plus his operation and maintenance charge. That would be relatively small because he has a small acreage and it will be intensively farmed. That is the vision I have of this valley, that the cost cannot possibly prohibit small-acreage tracts from being feasible under the conditions which you have mentioned. To me it means the difference between doubling or trebling the population in southern Nevada in the next 2 or 3 decades or of standing static. If an additional water supply doesn't come in, the water supply will decrease. It is worse than static. That is the continual danger that faces the property owners here.

Mr. NIELSEN. I think it is a real danger. We have seen it in other areas that have overdrawn their ground water, people have to draw out, and as they draw out, and take their economic losses, those who can best afford it stay with it for a while and after enough people have dropped out, those who stay get along. Then we start the cycle all over again.

Senator MALONE. The same thing is going on in this power picture down here. Right at the moment we are going along and from the outside prospects are bright but when you get down to the testimony, they don't have enough power to run their present setup and not one of them will invest an extra dollar until we get the power in sight, to operate it when it is ready.

Mr. NIELSEN. That is right. I do want to say some more as to what the reclamation is doing in the southern Nevada picture. As you

know, we have been asked to install Boulder Dam generator N–8, which won't give us any more kilowatt-hours but it will give us better kilowatt-hours. We have done work on Bridge Canyon where the answers are now more political than they are engineering. That is, we could move into Bridge Canyon just about the time someone told us we had money to move in. The same goes with Glen Canyon. We have participated in that work, although that work is under the immediate direction of the Salt Lake City offices. Glen Canyon could proceed with construction without there being an engineering bottleneck, let me say it that way. The same thing goes for Marble Canyon. So that our activities, our reclamation activities are rather extensive in the southern Nevada area.

Senator MALONE. I might read the opening statement when I introduced the bill:

The present Bridge Canyon on the Colorado River is located at the head of Lake Mead, 117½ miles upstream from Hoover Dam. The capacity of this reservoir is 3,720,000 acre-feet. The power to be developed is estimated as 750,000 to 900,000 kilowatts.

According to the testimony, I was a little ambitious in that statement, but that is in the neighborhood, is it not?

Mr. NIELSON. Yes.

Senator MALONE (reading):

The dam will be 673 feet above the stream bed. The crest length of the dam 1,950 feet. The total cost of Bridge Canyon for the entire project will be $325,314,000, divided as follows: Bridge Canyon Dam and Reservoir, $224,604,000; Bridge Canyon powerplant, $92,219,000. Coconino Dam and Reservation on the lower Colorado River, for regulation purposes, $8,491,000.

Does that represent your general size of the situation?

Mr. NIELSEN. Except this, we must have above Bridge Canyon a silt detention reservoir.

Senator MALONE. For regulation and silt detention——

Mr. NIELSEN. Regulation makes it even better, but if you will recall, we had Bluff Dam on the San Juan River in our original plan for Bridge Canyon because the Glen Canyon potentiality wasn't available to us. That was knocked out in the Senate committee.

Senator MALONE. Who handled this before?

Mr. NIELSEN. The Interior and Insular Affairs. Now Glen Canyon is very active and we rather think Glen Canyon has probably just as good a chance of going as Bridge Canyon, looking at the processes. We do want Glen Canyon to come in with or very soon after, 10 or 15 years after Bridge Canyon.

Senator MALONE. Before Bridge Canyon got beyond repair because of retention of this silt.

Mr. NIELSEN. Any good engineer will recognize that 26 million acre-feet above Bridge Canyon and some 29 million feet below Bridge Canyon just makes a beautiful setup, powerwise.

Senator MALONE. You agree, I suppose, with the testimony of Harvey McPhail, Assistant Commissioner of Reclamation, that with the construction of Bridge Canyon and Glen Canyon together, Hoover Dam, Davis Dam, Parker Dam, with the coordination and utilization of power from those five projects, that practically all of their capacity would become firm power.

Mr. NIELSEN. That is right.

Senator MALONE. In other words, one of the purposes of this hearing is to show just that. I knew Harvey McPhail is one of the best engineers in the country as well as being in a position of authority to tell you it is true. Of course, if you could bring that about, that is a perfect situation on the river. Do you have anything further?

Mr. NIELSEN. No, I think that is all I have to contribute.

Senator MALONE. I want to thank you, Mr. Nielsen. I deeply appreciate your appearance here. I know you have left other work to do this, but I think in the long run it will bear fruit, to the effect that your authority as being in charge in this area, Harvey McPhail coming out from Washington, his authority, and then the power users' testimony, showing as it does the tremendous shortage of power even now under their present investment, and they are unable to make further investments until further power is assured. I think, speaking for one member of the committee, I knew most of these facts to start with because I am in close touch with your Bureau, Harvey McPhail and others. I think it will have a great deal of effect upon this committee when they see the coordinated testimony at the beginning of the year.

Mr. NIELSEN. Mr. Larson is here and he has pretty well digested all of the information we have on the work that you are going to think about and could give you that as he goes along. I doubt if he has any direct testimony he wants to give, have you, Vod?

Mr. LARSON. No; I haven't.

Senator MALONE. I would like him to make an appearance and make any general statement he would care to.

Mr. NIELSEN. He will be doing the planning work that is brought to us.

Senator MALONE. Suppose we call Mr. Larson now. Mr. Larson, you may identify yourself for the record and then make any general statement that you care to. You have heard the summation of the 2 days' testimony of last week on the power; you have heard Mr Nielsen this morning, and Mr. Hardman.

STATEMENT OF V. E. LARSON, REGIONAL PLANNING ENGINEER, REGION III, UNITED STATES BUREAU OF RECLAMATION

Mr. LARSON. My name is V. E. Larson, I am regional planning engineer, region III of the Bureau of Reclamation. I have no direct testimony prepared, Senator, but I will be glad to try to answer any questions that you may have in connection with our exploration or investigational program. If you like, I could brief you on some of the past history of some of our investigations in this area.

Senator MALONE. I would like for you to do that, and just tell us in a general way what you are now doing. You may proceed, Mr. Larson. I would like, if you would, to give us an idea of the type of work you have done, but particularly, if you were given the authority to proceed tomorrow in this area to investigate the feasibility, make land classification surveys or whatever would be necessary for the next step in regard to the six irrigation bills that have been introduced to utilize 900,000 acre-feet of water in this area, on about 200,000 acres, fully realizing as you do that there may be more or less land because even the State engineer in the inspection, that we were able to make

without actual surveys, the maps made at that time were utilized in the introduction of the bills, except the Mormon Mesa, and that we estimated from material available from other maps. There may be more or less land, but in order to determine the land in the area, that may or may not be included in these bills, just how you would proceed if you were given the green light.

Mr. LARSON. Well, naturally, Senator, we would start with the information we have, which dates back to the first report completed by the Bureau of Reclamation covering potential reclamation projects in Nevada with the Colorado River drainage area, in 1932. That report covered several potential areas for reclamation development. Then in 1936 another report was completed which considered the Las Vegas pumping project. Considerable work was done in connection with that project, but it was found to be unfeasible at that time. In 1944 a report was completed for the entire Colorado River drainage basin and again those potential projects were reconsidered and some additional work was done. That was followed up with a detail project investigation for the Moapa Valley project which seemed to be the most desirable of those projects. The next was the Fort Mohave project on which we have a report almost completed. There are, of course, several factors that have to be taken into consideration. One is that many of these potential projects involve jumping lifts, so that the availability of power is one factor that would have to be considered. Secondly, we know from the information we now have available that many of these potential projects would be rather costly and it is rather doubtful if any, or at least not many, would show the required feasibility under our present reclamation law.

Senator MALONE. What do you mean, under your present reclamation law?

Mr. LARSON. Well, that they would be able to pay the reimbursement cost within the 40-year period.

Senator MALONE. Why do you say that? What is your statement based upon?

Mr. LARSON. On the feasibility, that is without special authorization for the project.

Senator MALONE. Let's assume now that your investigation will bear out what I say I think it will and that is that you are not going to have any wheat farms out here—160 acres and all that—you are going to have 10 acres, 5 acres, 2 acres, maybe 25 acres or 50 acres like you have in the Reno area now where people come in to live and work, do most of their own work. I know what your procedure is probably as well as you do. I have had close asociation with the Bureau for a period of 30 years. You go out and figure out whether a farm of 20 acres or 160 acres is going to be feasible for a man to go out there and work who has no other connection. That is not what you are going to find here. I don't understand your statement that you don't think it is feasible when you have not ever considered it.

Mr. LARSON. Well, let's look at it this way, Senator: Assume that a farmer or assume that a man working in the area has 5 or 10 acres.

Senator MALONE. Maybe he has 2 acres.

Mr. LARSON. All right; suppose he has 2 acres. What, in your opinion, would be his repayment ability, for example—put it this way, how much more would he be able to pay for water than a farmer with 160 acres.

Senator MALONE. Ten times as much, because he is raising his beets, carrots, cabbage, and apple trees, and he has a job, and is doing most of the ranch work himself. He handles it himself. If his fertilizer or his lime or something else is needed for his land, he is not applying these soil conditioners on a big scale of 2 or 3 carloads where he has to pay cash for it ahead of time. He is on a payroll, and he is doing this to help live and make a small ranch home. He will do most of his own work. Ten dollars an acre would be nothing annually for a basis of repayment which would be on a 50-year basis. Twenty dollars wouldn't be anything, annually, as a basis for repayment without interest. Of course, you have to add your maintenance and operation, and you are going to find out what that will cost. That would be his principal expense, not the basic repayment at all. If you had 100 acres and depended on that alone for your living out there, and you had to go to the bank and draw out money to carry on, then you are in a different category.

Mr. LARSON. Well, in this Las Vegas area, for example, the cost of water would probably be between 20 and 25 dollars an acre-foot. Now assume that he has——

Senator MALONE. You are talking about the storage and the basic repayment. What would be your use factor for acre-feet?

Mr. LARSON. It would probably be about five.

Senator MALONE. Five, if it was $20, that would be $100.

Mr. LARSON. And if he has 2 acres, that would assess $200 a year for his water.

Senator MALONE. You are not talking about a year are you, that is including maintenance?

Mr. LARSON. That is including maintenance.

Senator MALONE. Yes, but let us just take the basic repayment now. You don't know what the operation and maintenance cost is going to be. Suppose that the cost for the installation and all of the basic costs, to get this land ready to open the headgate and put water on, supppose it is $100—it will be more than $100 an acre undoubtedly. How much do you think it will be? Forget your maintenance and operation, talk about your basic installation of your pumping plant and your ditch and getting ready to open the headgate. That is the thing you are going to scatter over 50 years.

Mr. LARSON. The basic installation would possibly be 10 or 15 dollars an acre. That would be spread over a 50-year period.

Senator MALONE. Acre-feet per year will be $10, we will say, then 5 acres would be $50; that would be a $1-a-year repayment. That doesn't amount to anything, not on 2 acres or 10 acres.

Mr. LARSON. But the basic installation wouldn't amount to much, but these annual maintenance and operational costs would, because, for example, on a lift of this magnitude, the power cost would amount to $8 or $10 per acre; per acre-foot per year.

Senator MALONE. All right, suppose it was 5 acres, suppose it was $50 a year per acre or $75, that doesn't amount to anything in 2 acres or 3 or 4 acres. Whereas in 100 acres or 200 acres where you are in large-scale farming it does. You are familiar with that kind of project. Out there at Phoenix, do you know what their annual operation and maintenance costs are? Do you know what it is down here

in California in some of their pump lifts? They are paying $50 an acre for rent down there for the land, some of them a $100 an acre.

Mr. LARSON. That is true, of course, but in many of those areas they have specialized crops. In California, for example, it may be that just 1 acre-foot is required.

Senator MALONE. I am talking about the fact that they pay $100 an acre for rental; sometimes it is as high as $200 or $300. That is just to rent the land and in addition they pay for the water. I am talking about people who don't go into intensive big-scale farming, like a commercial gardner would. I am not talking about the large area farms you are accustomed to. This is an entirely different situation. I see no reason for you to make a statement like you did, because you don't know a thing about it until you get into it. I can take you all over this area to see wonderful small-tract developments. I am sure you have been over some of it. Go out and look at the golf course at the Desert Inn. I rode out there yesterday. Some people say it can't be done, but suddenly it is done. You say that similar land is not suitable, that is what your department has said. When you went to work on the Arizona project, some of that testimony coming from your bureau made me sick. I don't think it came out of their hearts, I think they were directed to make it.

Mr. LARSON. I don't know particularly what you have reference to there.

Senator MALONE. I have reference to the Arizona Central Valley project.

Mr. LARSON. Yes, but what statement?

Senator MALONE. I could dig it up for you. I don't have any particular reference but you come down, your bureau, and approve investments, with interest on the power and water developments that no human being on earth would have been able to pay. That is something the bureau should have known more about than anybody else. They probably did. What I want you to say now, if you feel like explaining; what would you do to go ahead and find out about this Nevada land, not what you think you are going to turn down before you look into it.

Mr. LARSON. Well, on the basis of 5- and 10-acre tracts, we could certainly consider it on that basis and determine what the repayment quota would be and report accordingly.

Senator MALONE. Don't you have any original thoughts of your own on this? I mean people are here, and even the taxi drivers ought to understand it. They don't want to quit driving taxis particularly, but they want some place to live where they can raise a little stuff to eat. I am talking principally now for these people here now, not those I expect to come in, but those who are already here. You should be able to size up the whole situation as well as I can or better, since you are in the business 100 percent of your time.

Mr. LARSON. On a 5- or 10-acre tract——

Senator MALONE. Two-acre.

Mr. LARSON. All right, 2 acres. It would have to be considered on a basis of the amount of vegetables and fruit and such as that, the quantities that these fellows could grow on a 2-acre tract and the maximum that he could pay for that would be what it would cost him at the markets.

Senator MALONE. Have you ever seen any of these tracts where people are working and drawing wages?

Mr. LARSON. Yes.

Senator MALONE. You must have. They don't depend on the market, they depend on eating what they grow. Very few vegetables are grown in this area now, they are sent up from Los Angeles and other places. You must know that. A lot of it comes in by airplane. I think it would be a good idea to state what you would learn from an investigation and let the facts speak for themselves.

Mr. LARSON. That is exactly what we have programed, Senator. In other words, this area was set up in our programing for 1955 on any basis that the local people——

Senator MALONE. 1955, why 1955? There might not be anybody here by then, this water table will be 10 or 15 feet lower, and before you get a project built it might be so far down to water you wouldn't be able to economically use it.

Mr. LARSON. Well, Senator, during this summer, the peak demand for water in this area was 18 million gallons a day for domestic and irrigation use on their farms and such as that. They are negotiating now for additional capacity of 5 million gallons a day from the Henderson system.

Senator MALONE. That is the domestic users.

Mr. LARSON. That is right.

Senator MALONE. But what I am talking about is getting ready for the people that can use a few acres of land so that they can use this water, and assist the city as an auxiliary fixed labor population. In other words, furnish them water and land and they will stay. I know what Las Vegas is trying to do, I am probably more familiar with it than you are. They were even scared to death about water when I was State engineer. We were studying the underground water supply and knew that very soon we were going to hit that balance, just as the State engineer has testified it did hit in 1945 and '46. Then they began to overdraw the supply.

Mr. LARSON. That is right, that is what is happening now.

Senator MALONE. Yes, now if you go to work on furnishing them domestic water without any other project, that is going to be very expensive, and they might have to bond themselves for it, whereas, they might be able to come in on this other kind of a deal that would be much less expensive, and without this bond issue on part of the project. What would you do about this tomorrow? I am in the engineering business. On similar work we always went in and made a reconnaissance and took it one step at a time and justified it, just as we did on the lower end of the Humboldt River before we brought you in here. When you run into something that is not feasible, you quit; if you don't you go ahead and build a project. We have no preconceived notions as to what we are going to turn down before we go in.

Mr. LARSON. I don't think the Bureau has had any preconceived notions on any of their investigations here. It has been the policy of the Bureau to work out a feasible plan for these developments and as we are investigating a development, the State or local people were taken into consideration, any suggestions they have are certainly considered. Even after we reach the point where the report is completed under the Flood Control Act, it goes to your Governor as well as

other interested States for comment, and before it reaches us we have certainly considered all suggestions that any local people have.

Senator MALONE. But you started out by saying you were going to turn down about two-thirds of these lands before you got started, you didn't think it was going to be feasible.

Mr. LARSON. No; if I said that it was certainly incorrect, because I say we would start with the information we have available and add to that, supplement it, as we need it. We have some preliminary information on many of the potential reclamation projects.

Senator MALONE. You do have reconnaissance air survey, do you not?

Mr. LARSON. No; we don't have any aerial surveys, practically all of the work that has been done is ground surveys.

Senator MALONE. Would the aerial surveys be helpful to you?

Mr. LARSON. Not particularly, for detail.

Senator MALONE. Would they help eliminate and determine where you are going to make your details, or are you past that point?

Mr. LARSON. I think we are past that point, Senator.

Senator MALONE. Well I will tell you, I hope you are getting back on the basis of feasibility and not a political survey, because you have made several political surveys in the last 2 or 3 years that don't look good to anybody. I can prove that to you if you are interested but I don't think it is necessary.

Mr. LARSON. Would you call our survey of the Moapa Valley a political survey?

Senator MALONE. I would not, but if you want me to name them, I will name a few to you privately. I don't think it is necessary to do it publicly, but if you insist I might do it privately. I have heard some of your testimony down there—not you particularly, but they simply supported something that had to be done some other way. So I just hope your agency will become the old Bureau of Reclamation again that some of us thought we were saving from extinction in 1932, when six of us organized the National Reclamation Association, and met in Salt Lake City and gave the dying Bureau the biggest boost it ever had. I am still behind it, but you have plenty of enemies now, and you are going to have some more if you don't start rolling. I think you have a great organization, there are some great men in it. Their lives have been spent in it, but we are going to have to start looking at the facts and not read the menu backward. What I hoped you would tell me is how you start on one of these reconnaissance surveys. What you would do next in order to determine the feasibility under the conditions that exist at the present time.

Mr. LARSON. Well for example, in my opinion in starting into this area, we would have to consider every potential route for bringing water into the area. The second point would be to get the water in by the cheapest method possible. In a development such as this naturally there would be several alternatives. Then in bringing water in, the next step would be to determine the amount of water that would be required, and how it would be used. If it is to be used on small acre tracts that is one thing. If it is to be used on larger areas that is something else. Let's put it this way, and assume that the city of Las Vegas as it is now laid out, requires a certain amount of water to take care of their immediate goal. They wouldn't consider contracting for

that amount of water whatever it might be, but in order to take care of additional growth they would say, we will take in area No. 1 so we can expand and have a water supply and we will subsidize that water for irrigation on a temporary basis and until such time as we extend the area we will have a definite water supply. There are several combinations such as that, that would have to be considered.

Senator MALONE. I think that would be considered as a municipal asset and then as Mr. Nielsen said there are these urban tracts, or subsistence homesteads, because whenever you get someone on every 5 acres or every 10 acres or every 3 acres you are getting close to an urban center. Wouldn't that all develop in your investigation?

Mr. LARSON. Yes, that is right; and that would all have to be considered, and it should be considered, naturally, with the local people.

Senator MALONE. Then wouldn't the matter of availability of power, in other words, back up a little on that, at least it used to always be our procedure to try to estimate the factor of feasibility as to where your area is going, whether it is growing, whether it is going to remain static, or whatever is going to happen to it. In doing that you would investigate the factors that contribute to the growth. Then, if we should suddenly authorize the construction of Bridge Canyon and Glen Canyon, and you knew that in 7 years there would be 1,500,000 kilowatts additional power going into the Southwest with a reasonable assurance that 200,000 or 300,000 kilowatts would stop here, wouldn't that have some bearing on your feasibility surveys?

Mr. LARSON. Well, the cost of power would definitely have a bearing.

Senator MALONE. What I am talking about now, you know that this area would double in population, wouldn't that factor have some weight with you in determining the feasibility?

Mr. LARSON. Yes; it would definitely.

Senator MALONE. Then that would be a factor, would it not?

Mr. LARSON. Sure.

Senator MALONE. Then what is the use of saying it is not feasible until we get into this thing. You know the work is going to take you a few months, and during that time we may be assured that we will have this power that I have been talking about now for 3 days. You may know that we have made a contract for Shasta Dam power for 30,000 kilowatts, and that is merely opening the door for another 50,000 or 60,000 when Folsom comes in and for other plants on the Trinity and Feather Rivers. We have established the precedent now, so there is nothing in the way of it, so, while you are making these feasibility surveys, if you become assured that there will be 100,000 to 150,000 new kilowatts coming in from any area, including the Central Valley, that would be a factor, too, would it not?

Mr. LARSON. Yes; because that would influence the rate of growth in the area.

Senator MALONE. That is correct. Now we are getting someplace. Right now you speak as an engineer, and that is the way I thought you were going to talk, not as a Bureau official who knows ahead of time what he is going to do; most of them do, I must say, and I am sorry for that. You would come in as an engineer and start talking about feasibility and consider all these factors, some of which may happen even while you are making the investigation, then all would be considered; is that true?

Mr. LARSON. That is right.

Senator MALONE. I certainly should hope so this time.

Mr. LARSON. Well, all of those factors would have to be considered in estimating or determining feasibility.

Senator MALONE. You could have saved time if you had just said that at first. It has taken an awful lot of time to find it out. Do you want to say it? Do you want to explain for the record that that is what you would do? You would come in on an engineering basis as an engineer to make a feasibility survey, land classification, soil examination and classification, and all the factors that enter into it, and make your final report on that basis?

Mr. LARSON. That is right, Senator. We would have to follow that out in order to determine feasibility. One of the reasons that we try to determine somewhat in advance as to what is the possible feasibility is because, as you know, under the proviisons of our reclamation law, the investigation cost is added to the reimbursable allocation of any project, so we try to avoid any unnecessary investigation because if the prevailing factors are such that it looks as though the project would be entirely unfeasible, we go in and investigate it, spend quite a bit of additional money then that just builds up a charge against that particular project.

Senator MALONE. Often when I set in and listen to statements, I think you can forgive me, just how did you determine the feasibility on the Grand Coulee project? You handled some of that work, didn't you?

Mr. LARSON. I wasn't in the field on the Coulee project; I spent some years in the Denver office on design on concrete dam sections such as was used on the Grand Coulee Dam, but I wasn't in the field.

Senator MALONE. Now you understand that I favored that project. I was State engineer at the time and was on a national committee, the Public Lands Committee, by Presidential appointment. I rode with Dr. Meade—who was one of the finest men I have ever known—through the Milk River project down through the Minidoka and into Seattle where they had the big meeting. That was in 1931 and I went all over that potential project. We later, in 1934 or 1935, had 31 projects authorized in 11 Western States. The National Reclamation Association had related problems. It took $100 million out of that initial $3,300,000,000 that they had for erecting levees and other work. We just took that out and spent it on permanent projects. I am certain that there was no estimate really made. We knew the land was in there, we had to pump 600 feet, no soil surveys or anything else of detail was made.

Mr. LARSON. There have been many soil surveys made on the Grand Coulee project.

Senator MALONE. When did they start?

Mr. LARSON. The investigations started back in the early 1900's.

Senator MALONE. Not soil conservation surveys; I looked that over. What you have done up there is going to work out, I think. You have got the cheap power to pump the water just as we will have here. We went in and built the project and then we made it work.

Mr. LARSON. I think it is more than that, Senator, because up there the Grand Coulee Dam.

Senator MALONE. Nothing was underwritten whatsoever, that is true, isn't it?

Mr. LARSON. Yes; it was underwritten in this way, that the revenue from the sale of energy at Grand Coulee Dam would——

Senator MALONE. Would underwrite the irrigation cost?

Mr. LARSON. It would; yes.

Senator MALONE. But that is not what I am talking about. There were no feasibility surveys made or estimates made for the irrigation. You had no contracts to underwrite it. You simply went ahead and built the dam, you are now selling the water to settlers as they come in. It is not underwritten even to this day except as you make individual contracts. You have already expended the money. Now to sit here and tell me that you are going to make all these estimates and they have got to be out ahead of time. When did we undergo this great change that we have to determine clear out to the last degree just what the feasibility is before we start a project that don't cost very much to start with? In different areas are there different policies?

Mr. LARSON. No; the policy is uniform throughout.

Senator MALONE. Let's make it uniform then, just like we did at Arizona and like we did at the Grand Coulee.

Mr. LARSON. You continually mention the Arizona project, Senator, you know as well as I do that that was a requested project, and the State put up 50 percent of the investigation. Anyone can come in and request the Bureau of Reclamation to make an investigation if they put up at least 50 percent of the money.

Senator MALONE. But you don't have to pronounce it feasible because they give you 50 percent. They didn't give you 50 percent to build it did they? What you did was go over there and make an investigation and pronounce it feasible.

Mr. LARSON. Well if it is feasible in this way, if Bridge Canyon is an important part of the development, if it will repay its cost——

Senator MALONE. It certainly will, if you take the power at cost without pay.

Mr. LARSON. I wouldn't say without pay, Senator. A third of the energy in Bridge Canyon Dam would be used in pumping.

Senator MALONE. Who pays for that?

Mr. LARSON. Let's put it this way, a third of the cost of Bridge Canyon Dam was allocated to irrigation, a third of the cost of operation and maintenance was allocated to irrigation, and that assistance from power was used in repaying more than beyond what the formula was able to pay.

Senator MALONE. That is right. Why don't you start in here and do that?

Mr. LARSON. You could do the same thing, Senator, if you wanted to allocate your 17.6 percent of the energy from both Hoover Dam——

Senator MALONE. That isn't what they did up there.

Mr. LARSON. Then you could cover all of your projects.

Senator MALONE. That is not in the picture at all. I think that development on the river, located in Arizona gets more power than we do, so on what basis do you divide the power up there because it is located someplace else? I am familiar with the work you did on that, I didn't care anything about it, but that is something else. When I put this on the basis of reasonable allocation and division we are entitled to more water down here. There are two ways of appropriating water. One is by appropriation and another by allocation

through an agreement between the States. There has been no agreement on lower Colorado River water. There is a certain equity between the States, but where does the equity lie with 2,800,000 acre-feet out of the tributaries of the main stream of the Colorado going into Arizona and 4½ to 5 million going into California while Nevada has less than 75,000? Where does the equity lie? Now if the expense is the same more of the water ought to come here. When you start talking about expense all I ask you to do is review some of your projects. One of them is Grand Coulee and another one is the Arizona Central Valley. I didn't tell you I wasn't for them, because I am one of those who helped get Grand Coulee through. I am not against Arizona getting water for their Central Valley, but I am for Nevada getting the next dipperful, if it is feasible here. I don't like to be skipped by someone saying it is not feasible here, and that the water use is feasible someplace else, when as a matter of fact, I am certain you will find it just as feasible here as you will find it in Arizona if you will go ahead and investigate it step by step. We are not asking that a third of the power from any project be allocated for irrigation, we want to try to stand on our own two feet.

Mr. LARSON. When we speak in terms of feasibility, we speak in terms of whether it will pay off under the provisions of reclamation law, if it requires special legislation.

Senator MALONE. You didn't make your investigation in Arizona or Grand Coulee either, under that basis, because under that basis neither one of them would pay off, you would have to get some power at cost elsewhere. We are not asking for that help, but I am asking you for a survey to determine what the facts are. Then if we have to get some help, maybe we will go after it.

Mr. LARSON. I think, Senator, we have been doing that. For example, we have a report for you on the Moapa Valley. That report is completed. It shows that the project will pay out in 100 years. That report is available to take to Congress.

Senator MALONE. That is what I am asking for here. You did some work out there and that is what I am asking for here.

Mr. LARSON. That is right. We will soon have a report completed on the Moapa Valley and also on the Fort Mohave project. What we had in mind was doing the same thing in this area because as it appears now this would be the next most promising area for a development.

Senator MALONE. Now I think we are getting some place. In other words, you are going to make the same kind of a feasibility report on these projects that I have introduced, perhaps there may be more or less land than we have taken in because there have been no accurate surveys made, but you are going to make the same investigations you made on the Moapa.

Mr. LARSON. That is right.

Senator MALONE. That is good enough for me. You are not going to dismiss it ahead of time.

Mr. LARSON. Oh, no.

Senator MALONE. Unless you have some further testimony, I think that is very fine.

Mr. LARSON. I don't have anything in particular, unless there is some question you may have.

Senator MALONE. That is the only question I had. I wanted to know how you were going to go about it. If you go about it just as an engineer that will suit me fine. If you go about it as a political bureau I am going to raise hell, I am telling you.

Mr. LARSON. I don't think we had any intention whatever of going into it on that basis. I might say this, when we go into it your local people will certainly be taken into consideration. If they have any suggestions of developing in a different way than we are considering, we certainly want that suggestion.

Senator MALONE. They don't know much about it. They are sitting around waiting for a great bureau that understands how to do these things to give them some information. There was a little period in there from 1935, when I resigned from the Colorado River Commission and State engineer office until 1946 when I was elected Senator, I was not responsible for anything that happened. If I had been, you would have heard of me before. I am in the picture again and I know how to do it myself and I presume that you do. So, let's get together and do a job. That is all, unless you have some further statement.

Mr. LARSON. I have nothing more.

Senator MALONE. Let's see, we have Horace Miller here, president of the board of trustees of the Palo Verde Irrigation District. He has been waiting patiently all day and I know he is a long way from home. Would you come forward, Mr. Miller? Will you identify yourself for the record and proceed in your own way with your statement?

STATEMENT OF HORACE MILLER, JR., PRESIDENT, BOARD OF TRUSTEES, PALO VERDE IRRIGATION DISTRICT

Mr. MILLER. My name is Horace Miller, Jr. I am president of the board of trustees of the Palo Verde Irrigation District. We heard of your hearings here and we feel that we are right in the middle of what is going on.

Senator MALONE. I am sorry if you weren't formally notified. I asked Mr. Smith, who was former State engineer, to comb the record and make a list. I know that he did do that and if you were left out it was an error, I am sure.

Mr. MILLER. I have this short prepared statement. If I could read it, I know your time is valuable. [Reading:]

A study dealing with the power development and public works related to the Colorado River would be incomplete without including the problems dealing with the removal or bypassing of the Palo Verde weir at Blythe and an assured water supply to the Palo Verde Valley along with the possibility of making feasible the installation of a powerplant at Headgate Rock Dam.

The Palo Verde Irrigation District had a bill in Congress last session for construction of a canal from Headgate Rock Dam through the Colorado River Indian Reservation in Arizona with a siphon under the river to the Palo Verde Valley in California. Hearings were not held until June, hence the bill died in committee. Since the canal would be used jointly by the Indian reservation and by Palo Verde Valley, the bill had the support of Arizona and California Senators and Congressmen. The Palo Verde Irrigation District expects to have a similar bill introduced in January or February of next year. The construction of such a canal and siphon will allow nullification of the weir, thereby increasing the power potentiality at Headgate Rock Dam.

The Indian reservation and the Palo Verde Irrigation District are also interested in the construction of Alamo Dam on Bill Williams River. This dam, proposed by the Corps of Engineers and already approved by Congress, would eliminate a serious flood threat to the cultivated valleys below Parker Dam.

That completes our short statement, Senator. Are there any questions?

Senator MALONE. I would like to ask you what additional water under the appropriation you now have would be entailed in this proposal?

Mr. MILLER. None; we feel that the Indian reservation probably has the oldest rights and ours next and it doesn't entail any request for additional water; isn't that correct, Mr. Tabor? Mr. Tabor is our engineer and we just debated who would step up here, for I may be caught short on some engineering answers.

Senator MALONE. I see nothing against such a project that is well within the appropriated water. I am very glad to have you here and to have your statement as a part of the record to be presented to the full committee.

Mr. MILLER. Thank you, Senator. I hope you succeed with the things you are wanting to do.

Senator MALONE. Would your engineer like to make a statement or is that necessary now?

Mr. MILLER. I believe not, Senator.

Senator MALONE. All right. Now, we have Mr. John M. Finley here from the University of Nevada, United States Department of Agriculture, Clark County Extension Service. Mr. Finley replaced Mr. John Wittner in this area as extension director on the resignation or the retirement of Mr. Wittner. You may identify yourself for the record and proceed in your own way with your statement. We are glad to have you here today.

STATEMENT OF JOHN M. FINLEY, CLARK COUNTY AGENT, UNITED STATES DEPARTMENT OF AGRICULTURE, UNIVERSITY OF NEVADA EXTENSION SERVICE

Mr. FINLEY. My name is John M. Finley, I am the county agent for Clark County as you mentioned in the introduction. I represent the University of Nevada and the Clark County Extension Service, cooperating under the Department of Agriculture. Our work, primarily, is of an educational nature as you probably know. The Agriculture Extension Service was set up under the Smith-Lever Act in 1914. Through that congressional action and through later additions to that act, the extension service operates in each State in cooperation with the State university of each State. Also set up on a State basis is the experimental station. In our case, the experimental station at the university in Reno is carrying on research activity in all main phases of agriculture. Getting down to the county extension level, the work is primarily of three phases. First of all, the part that I am in is called the county agent work. That covers practically every phase of agriculture. We have calls come in from ranchers, farmers, stockmen, from homeowners. Any persons who have questions of any nature that concern agriculture, we try our very best to provide answers. We have available in the extension office, the work of research people, not only from our own research station but from all experiment stations, from the State experiment act, plus work from other research agencies, such as forest service. They are set up with research agencies under each region. Whoever provides the research,

we get the results, try to interpret it with the thought in mind of putting it into practical use under our own local conditions. The second phase of our work is the home-demonstration activity. That is called the home-advising phase and includes sewing, improvements, cooking, canning. In later years here, also, the preparation of food for freezers.

Senator MALONE. Who handles that end of your work here?

Mr. FINLEY. In this locality it is Mrs. Hazel Zimmerman, who is the home-demonstration agent and carries on that work for Clark County and also Lincoln County, which adjoins us to the northeast. The third phase of our local work is the 4–H. Through that we endeavor to stimulate leadership of the boys and girls in agriculture and do the work to provide them a basis for better citizenship and assume leadership in the agricultural community. We have one phase that is very, very important in the formation, and that is our demonstration work. For any phase that comes along, if there is an improvement, for example, in sanitation or permanent pasture. Any improvement that we see that might be made, we endeavor to get 1 or 2 to start it out and then through using that as a demonstration we have a meeting or field day and give that information with the practical application locally.

Senator MALONE. Are you interested, or have you been interested, in watching the development of the Moapa Valley project by the Bureau of Reclamation?

Mr. FINLEY. Senator, I have not, in the short time that I have been here, had very many contacts with the Bureau on that phase.

Senator MALONE. You are inerested, though?

Mrt. FINLEY. I am very much interested in the results and application.

Senator MALONE. And in carrying through the project if it proves feasible.

Mr. FINLEY. That is right.

Senator MALONE. That is the purpose of this hearing, as you know, to determine the demand for power in the area and its possible source in an auxiliary supply and to determine the feasibility. Now, how are we going to determine the feasibility of these six irrigation projects which I have introduced and, of course, additional land if it should develop there is additional land, and one of my projects includes the Muddy River? I have been aware of these investigations going on for some time because it fits right in with one of these projects.

Mr. FINLEY. I might explain the investigation that is under way at the Moapa Valley carried on through the cooperation of the Nevada Agricultural Station. There is set up a series of study blocks to determine the adaptability of various types of grasses and domestic plants of one kind or another to that ground, alfalfa, for example; there are several things that have been introduced recently from all parts of the world. We need to know locally just how they will be adapted.

Senator MALONE. I think, as Mr. Wittwer used to explain to me, they were getting into the production of tomato plants that were sent by air east, because in our climate here, they could develop them earlier in the year and their cultivation has become quite an industry.

Mr. FINLEY. It is, and without any form of protection from cold weather. The tomato seed is planted early in the season and by the time conditions become favorable for setting out plants in the Intermountain and Northern States, we have the plants ready to ship them.

Senator MALONE. And you have beet seeds and celery plants, very intensive farming, therefore in that area the land would bear a greater burden than it would in areas restricted to common crops?

Mr. FINLEY. Yes, it would.

Senator MALONE. I had in mind that the Bureau of Reclamation could explain their project there, but I think we are going to have to recess this hearing now. I would like to ask you, Mr. Larson, are you in this area now with the Bureau, here?

Mr. LARSON. Yes; I am located in Boulder City.

Senator MALONE. Then you would be available later in the week or next week to further explain what you have done in your investigations in the Moapa Valley in a little more detail for the record?

Mr. LARSON. That is right; at any time for your convenience.

Senator MALONE. That will be fine. You were stationed in Salt Lake City, weren't you?

Mr. LARSON. No.

Senator MALONE. Was that another Mr. Larson?

Mr. LARSON. Yes. He is my uncle.

Senator MALONE. Well, if you are available we won't necessarily have to complete it today.

Mr. LARSON. I am located in Boulder City now.

Senator MALONE. Then we will recess the hearing. Mr. Finley, would you be available at any time within the next few days?

Mr. FINLEY. Yes, I will. I would like to say at this time, Senator, that I followed in the footsteps of one of the most remarkable men this area has ever produced, Mr. John Wittwer, who has spent his life in trying to better conditions of the farmer in this area and through getting cooperation from all the agencies involved, to have them come locally and apply their talents in whatever line it may be.

Senator MALONE. You don't have to sell John Wittwer to me; I have known him for 35 years. I think you are exactly right. His integrity and character has never been questioned. That, then, unless you have a further statement, Mr. Finley, that is all. We were glad to have you here. Now, Mr. Lottridge has something to say about power. We will revert to the power supply and try to have the transcript show the complete power story and the complete irrigation story together. This has been necessary because of the availability of witnesses. Mr. Lottridge, will you identify yourself for the record and make any statement that you care to make?

STATEMENT OF RICHARD W. LOTTRIDGE, GENERAL MANAGER, PIOCHE MANGANESE CO.

Mr. LOTTRIDGE. My name is Richard W. Lottridge; I am in charge of the Pioche Manganese Co. The information that I am going to give you today should be tied to the information given by other power users at the Basic magnesium project and should appear in that part of the record. The Pioche Manganese Co. is a subsidiary of the Combined Metals Reduction Co. It was organized to process manganese ores from the State of Nevada. We are constructing a large preparation plant at Pioche and an electric smelter at Henderson. The first part of this electric smelter is nearly completed and we are about

ready to use power. We have, at the present time, contracted for, in firm power, about 10,200 kilowatts of capacity.

Senator MALONE. What does that amount to in kilowatt-hours per year?

Mr. LOTTRIDGE. That is what I was coming to; it is about 75,500,000 kilowatt-hours of energy per year. In order to run an electric furnace at full capacity, we require an additional 5,000 kilowatts and with that 5,000 representing the energy per year, 35 million kilowatt-hours. In other words, the point I am trying to bring out right now is that we do not have enough firm energy at the present time to run at full capacity although we would be able to operate. We have a program, this is at the end of it, we want to go ahead with further expansion so that projecting this in the future, within the next 2 years, we would require about 22,700 kilowatts of capacity or an annual energy requirement of 168,500,000 kilowatt-hours, or, in other words, more than double what we have now. However, that energy is not now available in firm. Our plans would allow us to carry on if that firm energy was available.

Senator MALONE. In other words, power that you have in sight, the Colorado River Commission has in sight, would be power from Arizona and California already committed to that State and only available to you while they were unable to use it or did not use it, therefore you could not very well make a further investment based on the availability of that sort of power.

Mr. LOTTRIDGE. That is correct; the only reason most of us are in here is because the power is available and we can't go ahead any further until there is more power.

Senator MALONE. If you were unable to get any additional power it might even jeopardize some of the investments you have made now?

Mr. LOTTRIDGE. That is correct. We are now depending actually on what is called, or we will be in the next power year, on what is called dump energy. In other words, it is due to good water conditions this year there is that much additional water temporarily in the area to produce dump power.

Senator MALONE. That is also dependent upon the sufferance of another agency or State?

Mr. LOTTRIDGE. That is right. It would, depending as I understand it from the Commission, be offpeak energy.

Senator MALONE. Offpeak energy then is at the sufferance of another agency, they are simply allowing you to use it pending the time when they can make full use of it themselves, which would be a very thin case upon which to make new investments.

Mr. LOTTRIDGE. That is right.

Senator MALONE. You have heard the testimony of Harvey McPhail, Assistant Reclamation Commissioner, and he is, in my opinion, the best power man in the country, that if we completed the development of the river at Bridge Canyon and Glen Canyon as contemplated under legislation by bills I have already introduced, that practically all of the 22 million kilowatt-hours a year would be firm power. That would increase the kilowatt-hours in the 36 percent of firm power to Arizona and Nevada, that would increase the amount of that power, and make it all firm. In your opinion, that would be a very desirable program?

Mr. LOTTRIDGE. Oh yes; from the information that I can get, I think it would.

Senator MALONE. Also the withdrawals from Shasta and other dams in the Central Valley of California?

Mr. LOTTRIDGE. Of course, not speaking for my company but speaking in general, I believe that there is now and is going to be a greater demand for power in this area and we can easily absorb all of that.

Senator MALONE. You may be familiar with the fact, that in 1930 when we were determining the disposition of the Hoover power, we naturally could use no power at all here when the dam was completed because we had no industry and we had no demand. I had written numerous briefs showing that we could use it in the future and asked for withdrawals. We were about to get sidetracked on power, just as we are on water now. I bid on all the power to be had at Boulder Dam then, now Hoover, which was about 700,000 kilowatts; a tremendous investment. Not that we wanted all of the power at that time or could handle it, but we simply could not have seen all that power sold to someone else without provision for Nevada withdrawals. So, in lieu of the bids, in lieu of allowing us to take the bids for the withdrawal, at that time I wrote a brief saying that we could use 175,000 horsepower within 20 years. I also said that we could use all of the power from Boulder Dam, in this area if they would give us time. We are beginning to reach the point where we could do that.

Mr. LOTTRIDGE. Of course, you are familiar with the fact that we are about a quarter of a million kilowatt-hours short or will be this next year.

Senator MALONE. Yes. Kilowatt-hours short almost immediately and that says nothing about the future. In other words, if we were assured right now that we could have all the Hoover Dam power in the next 5 years, we would just about take it up.

Mr. LOTTRIDGE. Well, I guess that is right.

Senator MALONE. There is no question about it now in anybody's mind. The question at the time—there was no industry in this area and the Secretary of the Interior simply made the flat statement that he didn't think we could use any power here. Now, as I say, we are in the same position with the water. We are using about 75,000 acre-feet and the big smokescreen still goes on. Mr. Lottridge, I am very glad you were able to come here. Will you be available for further statements if we recess the meeting?

Mr. LOTTRIDGE. Yes; that is right, Senator. We were very glad to be able to make a statement, because we are short of power; we need it, and other people do, too.

Senator MALONE. I think there has been a very sound foundation laid for future development. Mr. Wittwer is here. Mr. Wittwer, do you care to make a statement now or just stand on what the present extension director has said?

(A lady asks permission to make a statement.)

Senator MALONE. Will you identify yourself for the record?

STATEMENT OF MRS. MURIEL REYNOLDS, SECRETARY, VEGAS VALLEY FLOOD-CONTROL COMMITTEE

Mrs. REYNOLDS. I am Muriel Reynolds, secretary of the Vegas Valley Flood-Control Committee. I will bring a lot of these figures down to individual levels, as I have them here. We have been working with

the county agricultural extension agent, mostly with Mr. Wittwer. He has been helping us and doing some very fine work on our place. We have a small place of only 40 acres, and a lot of our friends and neighbors have anywhere from 2 to 5 to 10 acres. So, we are very definitely interested in these irrigation and subsistence farms. We know that various crops can be grown here. We have proved it. We know, also, the local variations in temperature. We know, too, that subsistence farms are practical despite what the Bureau of Reclamation has said.

Senator MALONE. Don't—this is a friendly exchange here. I know what they are going to do. They are going to do their best to provide water here if there is any place to put their feet on feasibility. The Bureau is a good organization, Mrs. Reynolds.

Mrs. REYNOLDS. I don't doubt it. What we need desperately and must have at a reasonable price: we must have water and we must have flood control. Our own well, in the last 2 years, which is a comparatively small well, has dropped from 720 gallons an hour to 512 gallons an hour. Our pump is a one-horse pump, and it could handle more water than it has. This increase in waterdrop makes it increasingly harder and harder to have a garden, and there is nothing like good homegrown vegetables. Getting back to the irrigation system, I have lived in the Imperial Valley, where they have a real irrigation system. I know—and I imagine you know all too well—that with irrigation comes drainage problems. It is a problem to get the water off the land as well as to get it on the land. Perhaps some of these drainage channels from the irrigation system could be incorporated in a little flood control which we also need so badly.

Senator MALONE. It has become well known and recognized by engineers that any irrigation district must be accompanied by drainage.

Mrs. REYNOLDS. After listening to Colonel Shuler's statement, if I get it correctly, the Presidential order will O. K. these channels as long as no critical material is used. As far as we can see, no critical material will be needed for local flood-control work, which could be incorporated into overall flood-control work. When floods hit a community, especially out here on the desert, it not only disrupts the home; it gets so bad sometimes that the men can't get to work, and that upsets the industries. I would like to submit this statement that I have prepared, authorized by the Vegas Valley Flood-Control Committee, which I gave you a copy of there.

Senator MALONE. Yes; I have a copy. It will be an exhibit in your testimony. Do you have a family, Mrs. Reynolds?

Mrs. REYNOLDS. I have a husband.

Senator MALONE. What does your husband do?

Mrs. REYNOLDS. He is a mechanic at Bonanza Airlines.

Senator MALONE. In other words, you are just about representative of these subsistence homesteaders. We certainly thank you, Mrs. Reynolds, for your appearance. Are you satisfied with the procedure contemplated by the Corps of Army Engineers and the contemplated land classification and soil surveys for irrigation?

Mrs. REYNOLDS. The thing that is worrying most of us is the fact that the water is dropping so rapidly that we can't wait too many years.

Senator MALONE. Well, we can do no better than to start now. If water is brought into this area, it will contribute very greatly to the ground-water level. That, of course, depends on the texture of the soil. It is of general record that an irrigation district raises the water table. I think it will help here in both ways. We thank you very kindly.

Mrs. REYNOLDS. Thank you, Senator.

(The statement referred to is as follows:)

THE REGIONAL PLANNING COMMISSION OF CLARK COUNTY, NEVADA,
Las Vegas, Nev., October 7, 1952.

PUBLIC WORKS COMMITTEE,
United States Senate, Washington, D. C.

GENTLEMEN: This is to inform you that the Regional Planning Commission of Clark County, Nev., considers that a very real problem exists regarding the adequate dispersal of stormwaters in the Las Vegas Wash area. Many natural drainage areas have been eliminated by use of the land for residential development, and the clearing of land over a large area has accelerated the rate of runoff.

It is the understanding of this commission that a survey for flood control by the Corps of Engineers has been authorized by Congress, and this commission strongly recommends that every effort be made by your committee to assure that funds are appropriated in the next session of Congress in order that this important survey may get underway.

Respectfully,

WILLIAM R. WALKER,
Director of Planning.

VEGAS VALLEY FLOOD-CONTROL COMMITTEE,
Las Vegas, Nev., October 9, 1952.

PUBLIC WORKS COMMITTEE,
United States Senate, Washington, D. C.

SIRS: We understand that through the efforts of Senator George Malone Congress has authorized a preliminary examination and survey for flood control and allied purposes of the Las Vegas Wash, to be made under the direction of the Chief of Engineers; also a preliminary examination and survey for runoff and waterflow retardation for soil-erosion prevention on the same drainage area, to be made under the direction of the Secretary of Agriculture.

Now, the next very necessary step is to see that Congress appropriates sufficient funds so that adequate surveys can be made by the Corps of Engineers and the Department of Agriculture.

Plans for the handling of flood control, we feel, should be on a broad, comprehensive basis, covering the entire Charleston Mesa area, so that any piecemeal work that is done can be incorporated into the overall plan. We have an outstanding example of piecemeal work, with no thought of the whole picture, now under construction on Highway 91, in North Las Vegas, Nev. The State road department is diverting a considerable area of North Las Vegas and a portion of Las Vegas into a stormdrain and diverting it down East College Avenue, the main artery for Vegas Valley. This work in itself is commendable. However, there has been no plans developed as to what happens after the runoff leaves the drain a few hundred feet from the highway and joins with local natural runoffs. The mayor of North Las Vegas and the county commissioners are stymied from lack of funds as well as insufficient knowledge of the overall problem of drainage in this valley. The drainage system now installed, at runoff periods will be absolutely swamped and, together with local runoff channels, will be somewhat nullified.

We are working to set up a flood-control district, so that everything possible can be done to facilitate getting this very important work accomplished and maintained.

Here in the desert we have the peculiar phenomenon of too much as well as too little water. Cloudbursts—typical of desert country—in a few minutes present the problem of too much water. The flood-control program should eliminate this runoff problem. Tied in with this is the problem of lack of water, in one of the fastest growing communities in the entire Nation. We know

from our own well that the water table is dropping alarmingly fast. Life in any form cannot exist without water. Without it, this wonderful western community will die out and once again revert to a nonproductive area, which would be a loss to the Nation as a whole. Therefore, water must be diverted from the Colorado River, so close to Las Vegas and surrounding communities that it is sheer stupidity not to avail ourselves of it.

In our humble opinion, the advent of irrigation often brings drainage problems. Thus the flood-control and irrigation canals could in large measure be an integral unit, with irrigation bearing a considerable share of the cost.

Respectfully submitted.

W. A. REYNOLDS, *Chairman.*
M. REYNOLDS, *Secretary.*

Senator MALONE. Now, I have Mrs. LeRoy Waggoner here. She wishes to make a statement on housing, which is, in some ways, connected with the whole problem. You may come right here, Mrs. Waggoner, and identify yourself for the record and make any statement in your own way that you may wish to make.

STATEMENT OF MRS. LEROY WAGGONER, HENDERSON, NEV.

Mrs. WAGGONER. My name is Mrs. LeRoy Waggoner, I live at 136 West Basic Road in Henderson, Nev. I certainly appreciate the opportunity of being here. I just want to point out that 350 families out in Henderson are facing eviction out of homes that we have had—well, we have lived in ours 7 years this month. We have been there through thick and thin, my husband having come out of the service after 6 years and made our home here. I am a native Nevadan. I met him stationed at Las Vegas. We dreamed of coming back and living in Nevada when the war was over. My father was a police officer in Las Vegas in 1933 and was shot and killed. I feel that in itself would be one way of repaying one of his daughters who he left almost an orphan, because my mother had us to make a living for.

Senator MALONE. It kind of establishes you, anyway, as a part of the area.

Mrs. WAGGONER. That is what I felt like. I have 3 small boys; all 3 are in school. One is 9, one is 8, and one is 5. When my husband came out of the service he used to work at the post office for 82 cents an hour. He worked there until they could find someone else, because it was hard to make a living, even in those days. Then he went to work at the plant. He worked for Mr. Atkinson, for War Assets, and Wecco. He worked for nearly all of them, and as they moved out he would seek employment elsewhere. When we moved in they were practically begging people to move in. It was practically a ghost town, you might say. I had the privilege of looking at about 50 houses, and there was nothing said then that we would have to get out if he didn't work at the plant.

Senator MALONE. This was during that interval of unemployment due to the stoppage of work at the Basic Magnesium plant and before other industries had progressed to the point of employing many men?

Mrs. WAGGONER. Yes, that is true. So, he worked at the different places, sometimes he would be out of work for months at a time and we would hang on by social security. Then he went to work for Stauffer Chemical Co., he worked there I don't know how long, taking different men's places while they were on vacation, then he got on steady as a laborer, then he got benzene blisters and the doctors at the

hospital told him he wasn't to work down here with the chemicals any more. Then, fortunately, Nellis Air Force Base opened up and he got employment out there. Stauffer kept him on for a year as temporary layoff, trying to find some place else where he might work. He has never been fired, so he has worked from that day, it will be 4 years next March, at Nellis Air Force Base as a maintenance supervisor. So, naturally when we heard of all this coming in, and all the plants coming in, he had offers to go back to work down there but he has worked up out there where he is making a pretty good wage where we can buy and he didn't care to go back to the plant. When they talked of putting us out if we didn't work at the plant I went all over putting my application in, it is out there now, even at the hospital for kitchen work at the hospital so that we would be eligible. That was about 6 months ago but I have never had any calls to go to work. If I could see that these houses that they are selling the people was helping the plant workers I would understand it, but otherwise not. The people working at the plant can come in now after they worked there 3 months they can buy their home for $250 down and a small amount a month. They want us to move out and give our home to people who have just come in, you might say just drifted in and all they had to do was work there 3 months and then they can rent their home or sell it for a pretty good price and go on elsewhere. We got a letter from John W. Gailbreth Co. last week stating that we were unable to buy our home but if we wanted to come down and talk to them about it that they would see us. My husband took off work a half a day and went over there and there was no system whatsoever and she said there are too many ahead of you, you couldn't possibly get in to see him that day, but she told us what he would have told us had we gone in. They told us that if we wanted to stay in our home, if we wanted to buy one of their new homes that they propose to build out there, that we could stay in it and rent it until we could move in. My husband and I said we didn't want that. We feel we are just as eligible for our home to buy it or sell it or rent it to get in one of the new ones like a lot of the other people are doing out there who have only worked there for 5 or 6 months. We know of 3 or 4 people, maybe more, who haven't even worked at the plant; it is just who you are and what you are that got their houses. I just don't think that is fair. That is just my case. Now we could buy one of their new homes, there are some of them right now, I have seen them with my own eyes that are falling apart. We would like to buy one of the new homes, but we would like to rent the one we are in and make a little money, too, just like the rest of the people. If nothing else, we would like to stay in the one we are in. We would like to raise our family there. It is very upsetting after being there all these years when they want to turn right around and give your home to someone who might be just drifting through here. We have neighbors right around us who are living for the day that they can go sign their deed so that they can go to work some place other than the salt mine, as they call the plant. That is my statement.

Senator MALONE. Mrs. Waggoner, what was the price that they would be willing to sell you a new home?

Mrs. WAGGONER. $400 down and $53 a month for a 3-bedroom.

Senator MALONE. What would be the total price that you would pay?

Mrs. WAGGONER. They said it would be $7,700. I imagine after all was paid it would come close to $9,000.

Senator MALONE. What would you do in the meantime, occupy the home where you are?

Mrs. WAGGONER. Yes; that is what they told us we could do.

Senator MALONE. What was the time that they thought would be required?

Mrs. WAGGONER. We talked to them about that and they said they thought it would be December before they started and it would be 3 months after that before the first one was finished.

Senator MALONE. It would be about March or April?

Mrs. WAGGONER. Some of the people have gone ahead and signed up for them with no intention of buying them just so they can stay in their homes, but my husband said this is still America and we don't like to be told what we have to do and what we don't have to do.

Senator MALONE. Of course, from the standpoint of the people who took the plant over, they took the houses and from their standpoint, they want to make the houses available for their own people. It is a little hard for me to understand it myself, how they could let you stay in one place in the house and then sell you a new house rather than letting you buy the house you are in and sell the new house to the new people.

Mrs. WAGGONER. Yes; that is what we thought.

Senator MALONE. I haven't had a satisfactory explanation of that and I have asked for it.

Mrs. WAGGONER. We haven't, either. If they need the houses so bad, why can't the new people coming in buy the new homes, it isn't as though they couldn't afford it.

Senator MALONE. You are probably familiar with the fact that I opposed the State taking over the plant to start with. I didn't think it would be a good idea. Nevertheless, they took it over. It was the wish of the administration. I suppose the State administration at that time, and after they took it over I said I would cooperate with them in any way I could to make it successful. Because after all, what we want to do, if you heard the testimony here this morning and during the 2 days last week, we want to build up the area and not allow it to flatten off like it now shows it is going to if we don't get this new power. I know now that we are going to get this power. It is just a matter of acquainting the committee with the factors that are necessary to follow on through in order to get it. After they took it over, I watched this whole development out of the corner of my eye. I left the State engineer's office before the basic plant was built and came back into the picture as United States Senator for Nevada in 1946. I had no responsibility in that interim. I felt, however, when I came back into the Senate that I did have a responsibility. You will remember I brought a committee here in 1947 and 1948. Senator McCarthy was with me. He is speaking here tonight. We did straighten out the power situation. The Colorado River Commission immediately applied for their power rather than letting California take the power at 2 mills at the switchboard and selling it back to us at 5½ mills here at the plant. There was a time necessary to secure the power so it was necessary to do that, and they did almost immediately. I am now chairman of this committee because there is no other Senator present to be chairman. I called on you because I thought you

had something to say that does affect the feasibility of the whole enterprise. The statements that I made over the last 4 or 5 years at intervals and made again about a week ago was to the effect that in my opinion the houses were built for a 10-year life and they have already run the 10 years, with 2 or 3 years over, and should be depreciated in values in accordance with the usual recognized methods and the tenant should be given the first refusal. If they do not want to buy the houses at the depreciated price, then sell them to anybody. If they did allow them to have the house, those who have lived there 5, 6, 7, or 8 years, and have been established taxpayers of the community, and build the new houses for the new people, because you can build them in 60 to 90 days. Especially in view of the fact that the plant allows you to live in the old house until the new one is completed makes no difference to the industry. I am going to do everything in my power, as you probably noticed today, to help these industrial people get the power and the water that is necessary to continue this industry, not on its present level alone but also to grow. That growth depends on the Bureau of Reclamation. I believe we could make another Phoenix in this area where you have industries to a certain extent, and they have a tremendous agricultural program. I say again, this is still my opinion, that the tenants should be allowed to buy their property at a depreciated price, and the plant operators should build houses for the new tenants. It is my opinion, too, that a large number of the folks, with work continually available, will come back to the plant. No doubt your husband will come back in the long run if there is a job suitable for his talents there.

Mrs. WAGGONER. Yes; he doesn't especially appreciate the long hot ride out there in the summer, but it is a better job than he can get there.

Senator MALONE. I have not changed; I still believe that is the way to do it. I am not going to make a prediction to you, but I am going to say you do not know yet of any eviction, do you?

Mrs. WAGGONER. No.

Senator MALONE. I doubt very much if there will be any evictions.

Mrs. WAGGONER. Well, they are going to take us out bodily, furniture and everything, because we feel we are just as eligible as anyone.

Senator MALONE. Most of the people there are relatively new; they are fine people. There are no better people there than Rollin Smith, head of the Titanium Corp. He has a headache all the time. He is trying now to decide whether to advise his firm to make millions of dollars of investments, hoping to get more power, but, if he doesn't get the power, the money will be lost. When I first met him about 3 or 4 months ago, I listened to him about a half an hour. He is a very emphatic man. Finally I said, "You let me worry about the power and you worry about your contracts," and that is the way we parted. So I got him the power and he took the contract—that is, we have the contract for 30,000 kilowatts he has to have for an additional 10-ton-per-day unit. He is now taking that contract on account of the Shasta power, and for no other reason. I have talked today with Finletter and his assistant on two different occasions. Next Monday I have a meeting with the Secretary of Air to talk about titanium. We have the commercial aircraft companies here. Harvey McPhail, as you heard discussed today, said there is no question but what we not only can't grow out there but we are going to decrease unless some-

thing is done. So you see these people there have grave problems. I am not justifying anything that might be wrong, but I want you to consider the headaches they have that perhaps keep them sometimes from considering the relatively small problems in detail. You can see that. Men like Rollin Smith and Fred Gibson and Art Newell are responsible to stockholders and if they make a mistake in recommendation they don't work here any more. The owners could lose a few million dollars on their recommendation. I am sure that as time goes on conditions will improve. I can't say that there won't be any evictions, but I think there would be very, very few.

Mrs. WAGGONER. If they do, they will have trouble when they start evicting veterans. I think it is a serious problem.

Senator MALONE. It is a serious problem but us veterans have no more rights than anyone else, I am one myself. I am talking now about the equities of the situation. That is about all they can do, they have to turn the housing over to somebody and it becomes very impersonal. As long as they have made that condition that you could live in the house until the new one is ready, you would probably rather have a house that is a regular house, built for permanency. You understand the magnesium business was a very precarious business, it was a temporary business so they built temporary housing. I am sure, as we pour this new power in there, there is permanent industry there now, so they will build fine permanent houses. If I were a new tenant I would rather have the new house myself, I wouldn't let you trade with me. As that develops, a new tenant goes in and takes the new house of permanent construction, good for 20 or 30 years without very much maintenance, then if he works 5 or 10 years and wants to leave he can get his money out of it much better than he could out of the old house. I am talking now of practical matters. I wouldn't be a bit surprised, after you get over the big scare that it will be very slow business. We expect same changes in the comparatively near future. I am very glad that you were able to come. I remember you and your husband very well. It is my hope that the situation will iron out. I must tell you again, don't put too much blame on the management. They have hundreds of problems. This problem is relatively small to them and maybe they never thought it through. They are fine people all of them.

Mrs. WAGGONER. All we ask is for them to be fair and consider our problems. Thank you.

Senator MALONE. Is there anyone else that has anything to say before this committee? If not, we will recess the committee subject to the call of the Chair. I anticipate there will be representation later from the Air Corps. I anticipated it this afternoon, but no one has arrived. I am sure that within 4 or 5 days there will be representation from the Secretary of Air's Office in Washington. I do believe that the hearing has already accomplished its purpose which is to lay before the Public Works Committee in January 1953 the exact condition existing with reference to the availability of necessary power and water in this area for the national-defense program and for the civilian program. The hearing will recess subject to the call of the Chair.

FLOOD CONTROL, POWER, AND WATER RESOURCE DEVELOPMENT, COLORADO AND MUDDY RIVERS, LAS VEGAS WASH, NEV.

MONDAY, OCTOBER 20, 1952

UNITED STATES SENATE,
SUBCOMMITTEE ON FLOOD CONTROL, RIVERS AND HARBORS
OF THE COMMITTEE ON PUBLIC WORKS,
Henderson, Nev.

The subcommittee met, pursuant to adjournment, at 9:50 a. m., in the City Council chambers, Las Vegas, Nev. Senator George W. Malone, presiding.

Senator MALONE. This is a recessed meeting of the Senate Public Works Committee to hear further testimony in regard to the power needs of the Henderson area with particular attention to the production of titanium metal and, of course, the materials that go into such manufacture. We have here today Mr. Roy Watkins, who is the Chairman of the Production Committee of the United States Air Corps and in charge of the Titanium Division. Mr. Watkins has been requested to represent several Government officials in his testimony here today, including the Air Corps and the Materials Purchasing Division and certain other divisions including his own. General Metzger, may arrive here Friday but could not be here today. Several witnesses will appear at a later date, on Thursday, Friday, or Monday of next week. It is believed the best thing to do, and this has been discussed with the principals, is to hear Mr. Roy Watkins in regard to the uses and the needs for titanium, a greater supply of titanium, and then allow the principals to submit briefs, simply recess this meeting and receive written briefs from the heads of departments that have been notified of the hearing. It is believed that method will answer the purpose of the committee when it convenes in January and will also furnish the information needed in the matter of the application which the Colorado River Commission of Nevada is expected to make within a few days to the Pacific Gas & Electric Co. in northern California, and the Southern California Edison Co. in southern California for a wheeling contract and a transfer contract to make the Shasta Dam power available in this area as intended by the contract which has been signed recently by the Chairman, the Governor, the Colorado River Commission of Nevada, and the Secretary of the Interior, representing the Government which owns and operates the Central Valley project of California where the Shasta Dam power is generated. It is well known and recognized that the Colorado River Commission of Nevada, representing the State of Nevada has the authority to apply and has applied for a certain

amount of power at Shasta Dam and a certain amount at Folsom Dam, which is supposed to be completed sometime in 1954, generating approximately 170,000 kilowatts, and 60,000 kilowatts have been requested from that project.

The Colorado River Commission has the authority to request the wheeling contract and a transfer contract from the P. G. & E. and the Southern California Edison Co. to deliver the power where the contract calls for, which is in Fallon, Nev., 3,000 kilowatts, and Henderson, Nev., for 30,000 kilowatts. Other dams will be constructed on the American River, the Feather River, and the Trinity River in the near future and the customers preference clause under which the Colorado River Commission has already signed this contract for 33,000 kilowatts from Shasta and requested 60,000 from the Folsom Dam can be exercised for further amounts of power. We have certain witnesses here this morning. I will ask for an identification of witnesses first. Is Mr. Roy Watkins present? Will you come forward and identify yourself for the record Mr. Watkins, tell who you represent and the people who have asked you to represent them in addition to the Secretary of Air.

STATEMENT OF ROY A. WATKINS, AIR MATERIEL COMMAND, WRIGHT PATTERSON AIR FORCE BASE, DAYTON, OHIO

Mr. WATKINS. I am Roy A. Watkins of the Wright Patterson Air Force Base, General Headquarters of the Air Materiel Command under Gen. Kern D. Metzger, Chief of the Production and Resources Division, Director of Procurement and Production, Air Material Command, United States Air Force and also the head of ACPR. That is the Aircraft Product Resources. I am the Chairman of the Titanium Committee of the United States Air Force as above described. I have received telegrams from Gen. Troop Miller, who is at Washington, D. C., in charge of the Washington level of the Production and Resources Section, as well as from Col. Ben Mesick, commanding officer of the Watertown Arsenal, who is in charge of the Ordnance Department there and Col. John Dieck, who is assistant to General Miller in Washington, D. C. Would you like to have the names of those who were to come Friday?

Senator MALONE. Yes; you might read into the record the departments of Government and other organizations that could not come today, some on account of the materials conference in Philadelphia, which I believe holds over tomorrow, but they could come Friday or Monday.

Mr. WATKINS. That is right.

Senator MALONE. You may read into the record then, those that prefer to come Friday or Monday.

Mr. WATKINS. First, I might say that I too was to have been in Philadelphia, Pa. at the Metal Trades Show starting on the 20th and going through the 23d. Most of all these people will be there because there are 2 days set aside for titanium, which we feel is the most important metal industry of today. Therefore, most of these people are all there taking a part or participating in this meeting. However, my general felt that it was much more important for me to come to Nevada to see about the power for the future than to go back to Philadelphia and just talk about it, so we are out here representing Brig.

Gen. Kern D. Metzger and trying to do what we can to get the power to help us. Now, either Friday or next Monday there was to have been here from the North American Aviation, Inc., either Mr. J. H. Kinderburger or Lee Atwood as his alternate, who is president of the American Aviation; Northrup Aircraft, Inc., Jack K. Northrup, president; Ryan Aircraft, T. Claude Ryan; Consolidated Aircraft, Gen. Joseph T. McNarney, who today has sent one of his representatives up here, owing to Mr. McNarney being in the East at this present time. I talked to him and he regrets not being here. He said he would certainly do all he could to help us. Fred H. Rohr of the Rohr Aircraft is sending a gentleman here today, but so far I haven't seen him. He is Mr. McCreary of the Rohr Aircraft. The one representing Consolidated Aircraft is Thomas G. Lamphier, vice president down there in charge of engineering. Then we have the Solar Aircraft, Edmond T. Price. Douglass Aircraft has Donald Douglass, Sr., president. Lockheed Aircraft Corp., has Robert E. Groves. Boeing Aircraft of Seattle has Mr. G. B. Gracey, executive vice president and general manager. Mr. C. W. Lamphier, who is vice president and general manager of the General Electric Co., wishes to appear later. He is gathering the data that is requested by the Senator. The same applies to Pratt & Whitney, the aircraft motor manufacturers, P. G. Guinn, vice president. Republic Aviation Corp., M. L. L. Brabham, he is executive vice president there and they are also preparing data to submit to us. I guess that about answers your question on that one subject.

Senator MALONE. All right, Mr. Watkins——

Mr. WATKINS. Oh I forgot, just one more, Admiral Dewitt C. Ramsey is preparing data, and also Clay Bedford, who is now president of the Safe Aircraft Corp., will be here Friday from West Trenton, N. J. He is also a member of the new Board that has been appointed for the Office of Defense Material, Washington, D. C. The other members of the ODM being Lt. Gen. K. B. Wolff, who used to be general in charge of all aircraft. Harold Vaunce, chairman of the board of Studebaker Corp. Manley Fleischman, former Director of DPA.

Senator MALONE. The chairman subcommittee will await word from the main Public Works Committee as whether to hold a further hearing here or to continue it in Washington. I will ask you a question; you represent these men, is it your opinion that they could round out this record and each one of them submit a brief that would be effective, and recess this hearing and hold another hearing at their convenience?

Mr. WATKINS. I think it would be better, Senator, to recess. As I said, I had only a few hours. I was in Boston at the time this call came for me to get out here, or I would have had many briefcases full of information and I am sure so would the other people. I might say for your information, Senator, that titanium is practically a new application in the Air Force.

Senator MALONE. Before we get into the testimony, I want you to make your statement which will represent, temporarily, these department heads that you have named. The chairman is inclined to simply recess the hearing today and allow these briefs to be presented and become a part of the record to round it out, and in that manner present it to the committee in January rather than attempt to have these

men come to Las Vegas. Do you think that would be satisfactory to them? I think that is what we will do today.

Mr. WATKINS. I think it would be much more satisfactory for two reasons. As you know, several people stated to you that they wouldn't be in a position to make a report until they had first talked it over with me, as I am the one who is making the survey. I think you would get more information that would help the national defense in that manner than you would by bringing them out here.

Senator MALONE. What is this report that they are supposed to have ready in about 4 weeks? Is it a general report that the heads in Washington are working on and also the heads of some of the aircraft industries?

Mr. WATKINS. I will tell you what that is, Senator. Washington has had this titanium information up to a few months ago when our general emphatically said: "Let's get that metal out and get it into the aircraft industry where it is usable." Up to that time there had never been a physical survey made excepting by the Aircraft Industry Association.

Senator MALONE. Is that a private company?

Mr. WATKINS. The Aircraft Industry Association represents all the private aircraft manufacturers. It has nothing to do with the Federal Government whatsoever. They made their own survey without any aid or information from us or as to what we were going to allow them for the difference in the cost. Therefore, their survey now is void because of the change in conditions brought about by you men in Washington and in the United States Air Force in picking up the blue chips between the cost of other materials and this material. Therefore, we had to in our Resources Division, through our section AFRA, we have contacted every aircraft industry, including engine producers and guided-missiles makers and airframe manufacturers. We are making a survey as to the quantity of titanium that will be required in the end item. By the "end item" I mean the flight-weight pound. When we talk of pounds, we speak of the finished-product pounds or the end; in other words, the finished product. For example, take this ashtray here. It might take twice as much material to make it as it actually contains when completed. That is the flight pounds that we are talking about. We are making a survey as to the uses, about which I cannot tell you now. I am not in a position to do so for two reasons. One, because of the necessity for security, because of the secret nature as to what we will use some titanium for. I could give you a few uses, such as in airframes and the engines. They will require a greater amount then in the guided missiles.

Senator MALONE. That information could be secured, of course, in an executive session later.

Mr. WATKINS. That is right; I could give you all the information of the survey.

Senator MALONE. And in these briefs that will be submitted; all the information will be contained in these briefs after we recess the hearing for 3 or 4 weeks, and perhaps reconvene in Washington. It would mean that we would have the results of this new survey that is now under way. Is that true?

Mr. WATKINS. That is right. You see, the reason for the delay here, Senator, is this: When I took this committee over, I wanted to get this information as fast as possible, but you know we had to get

an appropriation for the cost of making it. The appropriation came through only the week I left to come out here, the week before I went back to Boston on this ordnance matter. Therefore, the survey actually is in progress right at this time and we are rushing in every possible way. We have shot men out to every airplane factory and every airplane guided-missile plant to make a survey and come back very quickly and tell us how much end product we are going to need.

Senator MALONE. When you talk about end products, does that include the amount that is actually used in the product itself or does it only include the weights after pressing the forms out?

Mr. WATKINS. No, sir. The end product is what you actually fly in the air.

Senator MALONE. What is the waste generally?

Mr. WATKINS. The waste we would take from the sponge to the rolled part. Now coming through to the ore, reducing it into sponge and then melting it into the ingot. By the time we get it into the form of sheets we have last 50 percent.

Senator MALONE. What becomes of that 50 percent?

Mr. WATKINS. We cannot reclaim it. Your Bureau of Mines here is now working very hard trying to find a way to reclaim or remelt this waste metal. It oxidizes the minute a tool hits it and it becomes a machine. Therefore, by the time we get through, we only have one-quarter of the metal you folks turn out of here from Titanium Metal Corp. or Boulder City, we only get 25 percent of the actual weight of the original sponge metal.

Senator MALONE. If that is the case, until such a time as the Bureau of Mines or some other organization works out a way to reclaim this waste, when you speak of cost, $5 a pound for sponge or whatever it is and $16 for rolled material, you are really quadrupling that cost in the actual use of the raw material.

Mr. WATKINS. That is right, Senator; yes, sir.

Senator MALONE. So then, you need really 4 times as much, that is to say the estimate of the material you need for aircraft, the manufactured material, would have to be 4 times that amount.

Mr. WATKINS. That is right; absolutely. That is what I have been trying to impress on everybody. We talk about tonnage; they say so many tons of sponge out here, or pounds per day, whatever they want to talk about, that actually doesn't mean anything to us because we can't fly it. We actually only fly a quarter of what they make out there.

Senator MALONE. That is in the airplanes. So when you say 10-ton-per-day unit delivery contracts, which we have discussed from time to time as some unit which everybody understands as to quantity, you would really be talking in usable material of 2½ tons.

Mr. WATKINS. That is right.

Senator MALONE. So when your estimates back up, it means four times as much of the material has to be manufactured as you actually use in the completed airplanes.

Mr. WATKINS. That is right, and when a person is ordering at the airframe factory, as you will hear from Mr. Lamphier and some of these people now here, they well order twice the flyaway weight. In other words, they will figure on 50 percent for layout and loss through their production.

Senator MALONE. If this is classified you needn't answer: What are the current estimates of the amount of such material that should be under way at the present time? Should be under way in the manufacture, the capacity I am talking about now.

Mr. WATKINS. Well, sir, may I answer in this way? This information is classified, but I will go around to give you an idea. We know that every airframe manufacturer today is short of titanium. We are short in every place, including the ordnance, the Navy, the Air Force, everybody is short of the finished metal. Before giving quantities I would like to see my commanding general, I am his aide and this has all come to me too soon, I will have to talk to him, but I would like to read something bearing on your question. It is from a speech by Brig. Gen. Kern D. Metzger, who is Chief of the Production Resources Division. This has been cleared by the public-information officers of the United States Air Force. For your information, I will be glad to leave copies and release it to the press because it has been perfectly cleared. I have 5 or 6 copies. After my making a preliminary survey, I wrote here for the general, "Electric power plays the most important part in today's production of titanium sponge." The sponge is what we have to melt over here in the plant and put into ingots.

Senator MALONE. Bear in mind, Mr. Watkins, what we are trying to arrive at, perhaps you can help us right there, is the amount of power to produce the amount needed. We know in a general way that for every 10-ton unit per day it requires approximately nineteen or twenty thousand kilowatt-hours of power. It is the power that is the objective, the power needs are the objective of this hearing.

Mr. WATKINS. Twenty kilowatt-hours are required to produce 1 pound of titanium sponge. Therefore, required to produce 100,000 tons of titanium are 4 billion kilowatt-hours, that is sponge. Now remember, we come back again, that is only 25,000 tons flight weight. In other words, usable material. Now you can take 25,000 tons flight weight and figure it out. I am going to read here another thing from the general.

Senator MALONE. Twenty-five thousand tons of flight weight as I remember you have just testified would require 100,000 tons of production?

Mr. WATKINS. That is right.

Senator MALONE. Under the present conditions. We have Mr. Lloyd and Mr. Mastin from the United States Bureau of Mines here who may be able to give us information as to progress they are making in reclaiming this material.

Mr. WATKINS. We also, Senator, have a project back there, I didn't bring the data, I should have brought it, but we have a project at Battele Institute and we have three other projects trying to recover this. We don't feel bad about it, we are saving all this scrap, because if you will recall, I went through the same thing with stainless steel and magnesium and it was 15 years before we found out how to reclaim stainless-steel scrap. So, eventually, we may find a way to reclaim titanium scrap. It should not take long. You have got the smartest men right here at your beck and call out at the Boulder City Bureau of Mines station.

Senator MALONE. As a matter of fact, under the direction of the Bureau of Mines in Boulder City, most of the progress has been made.

Mr. WATKINS. All the progress in this country. They brought in the Knoll process. I could talk for hours about the good work done by the Bureau of Mines—what they have done to produce this metal that we need so much of right now for top flight. We also feel that if you would figure out on the tonnage which you will see at the time we give you the report, I think you will see 25,000 tons is a very small amount.

Senator MALONE. Now, considering it from that angle, 100,000 tons per year of this material would be, let's see, for each 10-ton-per-day contract, it would be about 3,600 tons per year, wouldn't it?

Mr. WATKINS. That is right.

Senator MALONE. 3,600 tons per year, if you needed 100,000 tons, you would have to let 25 or 30 of those contracts.

Mr. WATKINS. That is right.

Senator MALONE. If you really produced 100,000 tons of this material per year—we can pass over that for the present time—you go right ahead with your statement.

Mr. WATKINS. Now remember, in making this survey, Senator, that only covered the titanium production. That does not include the other four companies out there. You see, five companies bought this basic magnesium plant out here. They are the Titanium Metals Corp., United States Lime, Stauffer Chemical, Combined Metals Reduction, and Western Electric Chemical. Now all of those people are doing the washing together. They are using the same wash line. In other words, helping each other. That is not included in this figure.

Senator MALONE. Stauffer Chemical Co., for example, makes the chlorine that is used in the manufacture of titanium, that makes a commercial center.

Mr. WATKINS. A complete center, yes, sir. The TMC company are the only people in the world today that are self-contained in an area that can actually produce titanium right here.

Senator MALONE. Without shipping in to any other other area.

Mr. WATKINS. Now wait a minute, they have to go to work, however, and they are getting rutile coke of titanium, which is exclusive of their own product.

Senator MALONE. Where do they get this rutile?

Mr. WATKINS. Rutile now, 75 percent of it, is brought from Australia and 25 percent is coming from Florida. However, as you will see in here, this rutile is on the beaches of Redondo, and many different places, I have it right down here. As you know, one-sixteenth of the earth's crust is titanium and it is the fourth most plentiful metal in the world, exceeded only by aluminum, iron, and magnesium. Rutile and ilmenite are the two principal ores.

Senator MALONE. Where do you find them?

Mr. WATKINS. They are found extensively throughout the United States, Canada, India, Australia, Norway, Ceylon, Brazil, and Sweden. We have to give Russia credit for having one of the largest deposits. We have the largest and theirs is next.

Senator MALONE. Is it necessary to get this material from Russia?

Mr. WATKINS. No, New York, Minnesota, Rhode Island, Wyoming, California, and New Mexico have deposits. A man yesterday came to see me and said he had a large deposit near Denver from which ore could be shipped here. He showed me his maps. I didn't have time

to read his report. I believe that if this money we have, $5 million for exploration, is wisely used we will develop much ore in this country——

Senator MALONE. That money was set aside by Congress.

Mr. WATKINS. That was set aside by you legislators, you were at the head of that. I went back to Washington to see you about it. You set aside the $5 million for exploring the tailings of mines, as well as new deposits. You will find commercial ilmenite. We have here now two gentlemen from the Bureau of Mines that are better informed on that subject than I am. They will probably answer that.

Senator MALONE. It is a fact that there are several known deposits in the State of Nevada.

Mr. WATKINS. That is right.

Senator MALONE. It is just a question of getting the review or the study.

Mr. WATKINS. That is right, to see how to reclaim it.

Senator MALONE. Why do we receive most of this material, 75 percent of it from Australia?

Mr. WATKINS. That is done by another department, not by us. I would like to hear the answer when you get it. I can't understand it.

Senator MALONE. I heard that the ore was ready to be mined there at the moment we were ready to use it here. Some of the other deposits here had not been developed. It seems reasonable to suppose that we could transfer the business to this country and still secure the raw material at a reasonable cost.

Mr. WATKINS. Yes sir; and that is what I have said. We can produce this metal in the United States independent of any other nation in the world if we will explore our own beaches and our own fields and deposits and get the ore.

Senator MALONE. Let me ask you right at that point, and, I will also ask the Buireau of Mines men, because they are in very close touch with the United States Geological Survey which must be working on this product. In your opinion, the way you described this as the fourth most plentiful metal in the earth's surface, is there any question or any reason why we couldn't be self sufficient in the United States and certainly in the Western Hemisphere in the production of all the titanium that is necessary?

Mr. WATKINS. That is my belief. You go down to Redondo Beach—I walked down there and saw the black sands and I went around to see several well informed people and it is my belief that such areas can be made productive. Of course, the men appearing here after me can amplify that. They are metallurgists, while I wouldn't know one rock from another. I believe such questions can best be answered by someone who knows more about the ore.

Senator MALONE. It seems that the information has already been put out that it is one metal that can be produced without importing the ore. Then it comes down to the supply of power, doesn't it?

Mr. WATKINS. That is right. Could I add one thing before I get away from this phase of the subject, please? Russia is working this titanium, they have taken all the data from the records of World War II, after America grabbed Berlin for the Russians. They took the records over on the titanium. Japan is now offering to the Nippon Titanium Co. some very, very good sponge for sale here in the United States.

Senator MALONE. Are they offering it cheaper than we can manufacture it?

Mr. WATKINS. I can't say definitely. There is a manufacturer of titanium back here that will give you more on cost than I can. I could merely repeat his figures.

Senator MALONE. I want you to bring out this point, that the matter of the cheap Japanese labor would not be a large factor in the manufacture of titanium because the chief cost is power.

Mr. WATKINS. There is one thing that you would say here, we say that we can bring the titanium ore to the electricity without taking electricity way back inland some place to the ore. The cost of bringing in the ore would be low. I think those gentlemen will tell you the cost, I had it down here; I think it is from 2½ to 3 cents now and they deliver to San Pedro and ship it up here by rail; part of the ore goes by boat to the east coast. There are only two sponge manufacturers in the United States. One is here which is the outstanding, and the other is du Pont on the east coast. However, they have a continuous process here for TMC by which they reclaim all of the magnesium metal used in the process. It takes 1 pound of magnesium for each pound of titanium. Therefore, back at du Pont, they throw the residues out on a big waste pile, a mixture of titanium tetrachloride and magnesium. At Basic plant here they reclaim everything. These people are the only ones who make the sponge completely, without waste.

Senator MALONE. What I gather from your statement is that this is a more economic procedure here because they have a roundabout method and use the waste material.

Mr. WATKINS. You are right. Another thing is, there are 11 other manufacturers now beginning the use of titanium, taking the sponge from du Pont, for they cannot buy any from the TMC. They are getting into manufacturing and they have to start with titanium at $5 a pound. That is what the Government has assured them, which does not affect TMC because they don't stockpile it. These other people buy it and then from there on they have to start out in making these different titanium materials.

Senator MALONE. They roll it and make their own finished material?

Mr. WATKINS. They have to take it in the sponge form and make it into an ingot and then roll it, because the stockpiling down there in New Jersey is merely putting it into containers and storing it until the people want it, which isn't very long. They are using it right from hand to mouth now. Here is one thing I think you perhaps should be thinking about. After the Titanium Metals Corp. here make their large ingots, which are taller than I am, very large and heavy, they scalp it, by taking off the outside cover and ship it clear back to Waterville, N. Y. That is way back to Albany, N. Y.—just a taxicab drive out. Then, when the material is rolled or drawn, they ship the stuff back out to the west coast again to be fabricated. That makes extra freight costs. There is no reason why eventually, if you can get power, that you couldn't have your rolling mills right here and roll the metal and drop it over the hill to the Los Angeles area aircraft factories, because you have your loss of 50 percent by the time you get your end material. I am not talking about the end item, I am talking about the end material, such as metal sheets and other forms. We lose

50 percent from the sponge through the ingot after we scalp it and then you have your butt ends for drawing, you save your 50 percent of scrap that we are now paying freight on from here to New York and, then, that weight of scrap is discarded there. Should we ever be able to use it we will have to bring it back here to Henderson at another freight cost, which I think is crazy business. But if the power were here there is no reason why they couldn't set up a mill, because after the metal is in an ingot, Senator, the rolling of it, the milling of it is identically the same as with stainless steel. There is no difference. In fact, where it goes into a plant the men don't know the difference.

Senator MALONE. Let me see if I understand you correctly. Your first loss of 50 percent is in rolling the material, and that is the material that if you had the mill here you would not have to ship East. In addition to losing the freight you have that raw waste material left there and stored and, if and when they do work out a method of using it, it has to be shipped back here again. Now the other 50 percent, that is, the other loss that you mentioned awhile ago, is lost in trimming and manufacturing at the plant itself.

Mr. WATKINS. That is right. You see, in the layout if you have a template, you lay on the template and cut a counterpart out of the metal and then you have several pieces of metal left over that you can't use. All that trimming around there.

Senator MALONE. None of that can be reclaimed at the present time?

Mr. WATKINS. None of it. Nothing can be reclaimed.

Senator MALONE. It is in the same category as the first 50 percent waste which is in the East, 3,000 miles away from here which must be stored pending the time that it might be useful in again making titanium.

Mr. WATKINS. That is right. I have another thought. Various fabricators, even up in Reno, Nev., are making parts for the various airplane companies. They ship the finished product up there and they have the extra freight cost when they ship back. There is no reason why you folks here in Nevada at this part down here, I mean the whole southern district of Nevada, couldn't have a bunch of fabricators like Rohr Aircraft has and some outstanding people in southern California, make parts right here. Then the scrap material could go right back into the mill without that long haul back to the fabricator and shipment back to the mill for repayment.

Senator MALONE. What you are saying now may be something that someone has summarized and worked on for a considerable time. We have a matter of safety—a matter of security—and it is a good deal like that of the atomic-energy laboratories. About 80 percent of the personnel of the atomic-energy brains is scattered out, and is in Southern California, Cal-Tech University, California University, Massachusetts Tech, Boston, and other places that cannot be easily reached by air or submarine warfare. They are beginning to think of the security back of the Sierra Nevada Mountains, between the Rocky Mountains and the Sierra Nevada, in that great desert mountain area. Would that same thing apply to a certain extent or could it apply to the airplane industries? Say this metal, suppose we could secure enough power here to manufacture enough titanium for the use in planes and had enough power for the rolling mills, you already have chlorine manufactured by the Stauffer Chemical, and other

essential materials by other companies here. Suppose the airplane companies were to see fit to locate back in this desert area east of Henderson where there is plenty of domestic water and plenty of room, that would just about complete the whole fabricating setup, and complete the planes right in an area where all the waste material would be very well taken care of without extra expense and you would have the entire industry, from the raw material to the finished plane. Would that be possible?

Mr. WATKINS. It seems to me it would. Wouldn't only be possible but it would be probable because of another reason. I am not talking now of national security; that isn't in my category at all. I am just a plain manufacturer. But here it seems to me the trouble we have had in some of these towns, as you know as you have been reading the press, and are getting Senate reports, we are having one lot of trouble. The aircraft industry is having a lot of trouble right now out at Palmdale by having too many restrictions. First the airplane manufacturer goes in and builds up a nice plant. The first thing you know is somebody is living next door and puts out a wash on the line and soon it becomes a community of houses with various restrictions. Then they make these jet jobs and when they start up they blow rocks and cinders and dust for miles as they take off. The people are raising hell about it and they want the plant away from there. It seems to me up here you could set aside land in Nevada, of which we have plenty, for such industries where they would not be interfered with. If there was such a plant here it would be a wonderful thing. I know, because up at Fallon at that big airport, and at your airport here, you never hear the people here complain about anything. I think it would be a wonderful thing, but as I say, that is not in my category. You asked for my personal opinion. I think that industry ought to come here and I think if you get the power here, the industry will come here, as General Melzger said in his talk. The TMC and the other big concerns didn't come here for any love of southern Nevada. They didn't come here as a love affair at all. They came here because the last large block of hydroelectric power in the United States was here. I came to see you, and told you, Senator, there wasn't going to be enough power and that we need help. I showed you that that was the last large block in the United States that could be used.

Senator MALONE. That is what was then constructed. Now, Mr. Watkins, right at that point, as long as you have mentioned it, one purpose of this hearing is to promote passage of a bill I have in the Senate to build Bridge Canyon Dam which would produce something like 700,000 kilowatts of power, about the same amount of power produced now at Hoover Dam. That will be a 6- or 7-year job, passing the bill, getting appropriations, and constructing the project. When it is constructed, there will be in the neighborhood of 150,000 to 200,000 kilowatts. Then there is Glen Canyon just above Bridge Canyon. I have not introduced legislation on that but intend to. Someone will introduce the legislation upon the opening of Congress without any doubt. The testimony is so clear that it is needed. That will create about 800,000 kilowatts more, a total of 1,500,000 kilowatts known power coming in within 6 to 7 years, that is the share of it that logically could be expected to be

secured by Nevada and used in this area. It is apparent that that would answer the question you have raised, and would be sufficient power for considerable time, would it not?

Mr. WATKINS. That is right, Senator. I have gone further. I have worked with the Bureau of Reclamation here on it. On page 7 here is shown the survey for additional power sources that has been completed by the United States Bureau of Reclamation. The survey indicates that locating other dams above Hoover Dam on the Colorado River will produce additional electric power. That is Bridge Canyon, and you said "750,000 kilowatts" I think. I have 750,000 kilowatts.

Senator MALONE. I said "approximately 700,000"; 750,000 kilowatts is probably about right.

Mr. WATKINS. This is what they gave me down at the Bureau; 800,000 kilowatts at Glen Canyon, an equitable part as 200,000. They say that they have additional sites for 3½ million additional kilowatts up the line. I don't know what we could do with all that power; we could use it if available.

Senator MALONE. I think they meant other smaller dams at that point that not only produce some power but regulate the water.

Mr. WATKINS. That would make a total of 1,750,000 kilowatts; but that is, as you said, 5 to 7 years away. Senator, could I say one more thing here? It hasn't anything to do wtih the immediate thing.

Senator MALONE. What we want to do, Mr. Watkins, is to round this out to give the committee the ideas to show whether or not further developments on the Colorado River are necessary for this area and for national-defense purposes.

Mr. WATKINS. I think this is. Now, then, here, you know for every pound of titanium produced they require 1 pound of magnesium that is now brought in from Kaiser's plant down near Stockton, Calif. There is very little difference in manufacturing magnesium over titanium, but you have got the overheads of two companies. Now, just think. Wouldn't it be nice if some in TMC got into making their own magnesium which you can make right here. That would take 10 kilowatt-hours per pound, which is twice what titanium requires.

Senator MALONE. I thought you said "20 kilowatt-hours."

VOICE. No; that includes both titanium and magnesium.

Senator MALONE. Let's keep the record straight. The 20 kilowatt-hours includes the magnesium and the titanium manufacturing?

Mr. WATKINS. No, he meant dropping it in and reclaiming it. It is 10 for melting the ore and all. Then we have a vacuum process for taking off the titanium tetrachloride—that is what they use to write in the clouds with and to make smokescreens—and your magnesium for reclaiming that is the 10. That is why the du Pont people can't do it in New York. We made a survey in New York and they can't get one more kilowatt-hour. So, they just dump this material out as waste at the taxpayers' expense, on a high pile, and we don't reclaim the magnesium: it just stacks up there. Is that clear?

Senator MALONE. Yes, and then we will have Mr. Lloyd get into that end of it; too. Now, in the meantime, the power that we are able to secure through the customer preference clause through the Bureau of Reclamation Act, to use during this 6 of 7 years while these 2 Colorado River projects are being constructed, it is very important to be assured of this permanent supply of power. That is when you withdraw it at Shasta Dam or Falsom Dam or any of the 8 or 10 other

dams that will be constructed on the American, the Trinity, and Feather Rivers; then part of that power belongs to the State of Nevada in the same manner that the power from Hoover under the same type of customers' preference withdrawal, belongs to the municipalities and companies in California. There is some opportunity to get interim power, on a short contract, from southern California, power that they are not now using. Some of it may be Hoover Dam power, some Davis and some Parker, but that power could only be secured on some definite contract basis that where and when it is needed in the areas to which it belongs we would lose it. That is the power that I think the Colorado River Commission is now discussing with the southern California companies, the Los Angeles Bureau of Power & Light, and the Arizona Power Authority. What we would have to have to have to justify additional investments is more firm power as Rollin Smith has testified, more firm power before they can justify the millions of dollars in investments that are necessary. He was not discussing a new rolling mill or the airplane factories, he was merely stating his own need for constructing additional capacity for the manufacture of the sponge, and that they must have definite assurance of more permanent power. What is your idea about that?

Mr. WATKINS. You could see why he said that. I don't speak with authority on this, but I am giving you my viewpoint.

Senator MALONE. You speak from the standpoint of the Air Force. In other words, could you require them to make this investment and take these contracts unless the power is in sight and on a permanent basis?

Mr. WATKINS. You couldn't justify it because you couldn't make expansion that would be necessary in spending millions of dollars in here and then have somebody in Los Angeles wake up and say we are going to take the industry down here because some manufacturer wants it and has the necessary power.

Senator MALONE. The type of contract that would be necessary to make the Titanium Corp. would be one that would guarantee them that they would not lose any money by virtue of losing the power. In other words, if they only had it for 5 years and you let a contract to them and insisted that they go ahead and make the investment, you would perhaps put the usual clause in the contract that if they lost any part of their investment as a result of the withdrawal of power they would not lose financially, would you not?

Mr. WATKINS. That is right, and we could go further than that, for the national security. I don't think we would even consider a contract. We would have to go elsewhere, wherever we could get the power, because in 5 years, the way things look, the peak will be in 5 years and then we are going to need the maximum amount of titanium.

Senator MALONE. In that case perhaps, as Rollin Smith testified—he is head of the Titanium Corp.—if they cannot secure the necessary additional power here they would probably have to go elsewhere, to the Florida Sands or some other area.

Mr. WATKINS. That is what he told me, too. That is what the officials say back East, the very same thing; that until this power situation is over the hump they don't want to consider more than the contract they now have with the Government. In fact, they don't have ample power now if they are to meet our present contract which you

will get in your report. We don't want to tell how much, but it is about 90 percent greater than we are getting now.

Senator MALONE. Do you have any further statement that you would like to make, Mr. Watkins?

Mr. WATKINS. Let me think for a second. Yes; I made a note here of one other thing. In this survey of power, I talked to some people from the chamber of commerce. It seems that you are going to have to remember that you must have additional water. If I had had time to figure it out, I could have figured out how much more you are going to need in the way of power for that. Yo are going to need it in street lighting; you are going to need it in housing.

Of course, it is none of my business. I am just giving you this to think of: The citizens of Las Vegas, whom I have a lot of respect for, have their power for their water and sewage disposal and all the public uitlities, and this town is going to grow right down to the dam. You know how much housing shortages there are now.

Senator MALONE. You are predicting such a growth in the event we secure the power?

Mr. WATKINS. Yes, certainly; they would be foolish to come here without it. That is something for the local community; it is none of my business. I don't want anybody interpreting me as coming out here and trying to dictate to this little town at all. I am merely giving an opinion, dropping it in with the titanium project. What we are interested in is power for titanium and the manufacturing.

Senator MALONE. And, of course, the auxiliaries that go into the manufacture of titanium. What would you estimate, if you have thought about it, the employment might reach in 5, 10, or 15 years in this area, in the manufacturing area, if we were able to secure the necessary power? There are about 2,600 or 2,700 employees at the basic plants now.

Mr. WATKINS. We could figure on the number of houses. That is a good question. I would certainly like to figure it out, but here is the thing. They are producing only a tenth of what they are supposed to eventually produce now.

Senator MALONE. That is, of what they need.

Mr. WATKINS. Rather, of what the contract is with them, because we will have to wait for them to get additional power. They never meet required output; they can only figure about an eighth to deliver to us of what their contract specifices with the present power if you get no more power for them. That would mean that we would have an awful hard time getting through any additional expansion. To take this power from southern California on a temporary loan would be just like borrowing somebody's baby without adopting it and when it grows up to be useful the parents take it away. That is what might happen here.

Senator MALONE. What you are trying to say is if we could get this interim power from California it would tide us over until we could get permanent power. That would be fine; but you forgot the permanent sources—the Central Valley, Shasta, Folsom, Bridge Canyon, and Glen Canyon. Without them we might have a shock waiting for us at the end of 4 or 5 years.

Mr. WATKINS. That is right; it might be a terrible shock.

Senator MALONE. What do you think the employment might be? There are 2,500 men at the plants now. There would be a tremendous increase, would there not?

Mr. WATKINS. Here is the thing, Senator. This can expand so far that even the figures would look crazy if you tell them, because if we could get in here as close to the manufacturers as it always has been, with the steel mills, the automobile industries that have come into it, remember, we are talking of it from the Air Force viewpoint. We haven't once touched on Ordnance, which I don't want to do at this time, which is using 75 percent of the titanium today that is manufactured when we are only using 25 percent. So, you can see the tonnage actually required is unbelievable. The Navy already has parts which they have allowed to be exposed; for instance, the snorkel tubes. The Navy is giving us an awful fight, and it would be a wonderful thing if you could think of a nonmagnetic submarine that wouldn't draw mines. An airborne tank that could be airborne; that is, 40 percent less weight than the present tank, and we could drop them anywhere. It is 60 percent stronger, and I can't tell you what titanium armor-plate resistance is, but titanium has great resistance. And armor plate, the Navy could take all titanium made today for armor plate if we could allow them to do it.

Senator MALONE. In other words, you are telling the committee that if you had sufficient titanium at any reasonable price it would replace steel in nearly all moving equipment.

Mr. WATKINS. Well, look at the commercial end. Suppose your automobile fenders and accessories were made out of titanium. They would never rust, and it is acid-resistant. Take just a common thing like a beer can; you wouldn't have to line it or anything like that. Already the medical profession has gone all-out for it. These boys that walk around with artificial knees and legs are pretty near 100 percent titanium because it is noncorrosive. You can get a piece of it in your blood stream and it doesn't infect you like other metals. While I am not on the commercial end of it, I could go on all day and tell you of uses. The washing-machine people are trying to get it for commercial use but can't have it now. This is not just a war baby like the magnesium plant was. Everybody says we built that basic magnesium plant out here and what happened to it? We never did get to operate it. But titanium is here to stay and will replace many materials where strength is required and it isn't at all a war baby. I am only selling it on the aircraft end now. All I am interested in its use as a national-defense material. With the people knowing that it isn't a war baby, with everything being made out of titanium, it just seems like God has been a little better to Nevada than many other places in the world right at this time, by giving you this old magnesium plant equipment, having it empty and ready. Senator Pat McCarran and you, Senator Malone were solely responsible for seeing that that wasn't torn down brick by brick and destroyed. I want to thank you for it and I know the whole Nation does. It just seems as though everything stayed here for a purpose. I know at the time the Governor and you folks out here put over the bill to buy that plant and retain it up to the time that these people would come in here. Rollin Smith told me out there that they had very little work to go in and get those generators running, they were very well protected. The only thing I am trying to tell you is that titanium will be extremely useful in the commercial

world but right now we have to have it in military. I want to read one thing and then I will sit here and wait if you don't mind and hear the other witnesses and make notes. I am willing to help you. Let me read you what one of the smartest generals in the world says, Brig. Gen. Kern Metzger. He is the one who was to be here today, he is the top of the Air Force:

> The future progress in aircraft development after 1956 is believed dependent upon the availability of proper metals. The metals of today will be inadequate in producing the supersonic aircraft of tomorrow.

Senator MALONE. This is approximately what is reported and that is when a plane passes supersonic speed—we have some people here that know more about that—magnesium and even steel loses a considerable amount of its strength. That is one of the reasons you have airplane accidents after you pass that speed, whereas titanium loses none of its strength in passing that supersonic speed at 700 or 800 miles an hour. It is a necessary metal in any fast-moving object, such as guided missiles and so on. You are talking about employment, first you are talking about this metal, opening up the great fields and there being no dearth of the raw materials, it is merely the power that is necessary. Luckily they are getting into commercial atomic-energy power now. There is practically no limit to the amount of atomic-energy power if they are successful in turning this into commercial plants. The Atomic Energy Commission has, as you know, and as Dr. Hafstad testified a week ago today, stated that they are going to put in a pilot plant; they have already determined its feasibility and they are going to establish a commercial plant. That is when he testified Eureka, Nev., was high on the list and did fill most of the requirements. We hope it will be located there because it will show that you could locate one of those plants in any mining area where the load is proven. He has testified that each plant they construct will probably cost less. With unlimited power coming from atomic energy and unlimited raw material, as you testified one-fourth of the earth's crust is titanium raw material, wouldn't it be reasonable to suppose that when this goes into quantity production that it will replace much of the steel and aluminum used now in construction?

Mr. WATKINS. Yes; for more reasons than that. I could go into a lengthy discussion of that. For instance, right here there is a loud speaker that is plated. No doubt if we have an all-out war you won't be able to get that plated; it will be made out of titanium and all that plating would be eliminated. It may replace many different types of things in which we are now using tungsten and nickel alloys and stainless steel. That is what we are trying to save as critical material. We are not only in it as the Air Force but we have the Bureau of Conservation also under our general that I didn't tell you about. We are trying to conserve critical materials.

Senator MALONE. What about the need for nickel when you are using titanium?

Mr. WATKINS. We will not need it. Commercially pure titanium is made from your own ores. If you go to alloys, you can alloy it with one-sixteenth of the different metals—eight different metals so far—eliminating the critical alloys. You can alloy it with aluminum and other metals.

Senator MALONE. In other words, there is no tin or nickel produced in the United States and very little tin in Canada; we get nickel from

Canada. No tin or nickel from the United States. Titanium would eliminate the need for these materials. Is that what you are saying?

Mr. WATKINS. Oh no, but it would reduce the demand for them.

Senator MALONE. But what I am saying is that you would need far less of these critical materials.

Mr. WATKINS. That is right. In other words—wait a minute, let me correct that Senator. We already have a shortage of those critical materials and still are using them for alloying stainless steel and in the aircraft industry. We could cut it off from the aircraft and put it over into the list of critical materials that we need worse.

Senator MALONE. Then the conclusion that would naturally be reached from your testimony, is that as this material is manufactured in volume the price will come down. I intend to ask the Bureau of Mines some questions along that line because I know they are right in the business of laboratory investigations in that field right at the moment. Then this material would displace the steel, aluminum and other materials to a large extent and then we would not be worrying so much about iron ore.

Mr. WATKINS. That is right, we would not have to worry about those.

Senator MALONE. Aren't we then in a sort of transition period now? Metals that were unheard of for practical use 10 years ago you now can visualize as solving a question that mining engineers have been worrying about for a long time—the availability of high-grade iron ore.

Mr. WATKINS. Let me answer it this way. Titanium is a silver gray metal weighing 0.16 pound per cubic inch, 60 percent heavier than aluminum and 56 percent lighter than alloy steel. Its alloys are far superior than engineering metals in alloys on strength ratios. In other words, they are stronger and better. Now we talk about the cost. That always amuses me because, well I will not get into the cost of the operation of the Government, I won't say that, but here is the thing: In 1852 or 100 years ago today, aluminum was so costly to produce, it sold for $545 a pound; it was more precious than gold and silver. Emperor Napoleon III was presented the first aluminum in the form of a medal. Later Napoleon's honored dinner guests placed settings of forks and spoons of aluminum, lesser guests found only gold and cheap silver. It took nearly 100 years to bring it down to the low price of today. We have done more, Senator, we, the Bureau of Mines, the people we are proud of, the American people, have done more to bring down the price of titanium, which is much more expensive to produce than aluminum, they have done more in 5 years than it took over 100 years to do with aluminum. I have faith in those men out here. They can't tell exactly what they are going to bring the cost down to, but I have certain assurance from these people, that 1 year from now the price is going to be way down. I would rather have them answer it. In 2 years, it is just like I went through with aluminum and magnesium, with the increase of our quantities we would decrease the cost, which is natural. We went through it with stainless steel. We thought at first we could never use it. We went through it with magnesium; we went through it with aluminum. But, as quantity comes, as it will here, we will

reduce the cost. I say this, if we can get aircraft speed beyond sound and save the life of one boy over there we shouldn't even consider the cost. Now the Government has agreed, our general took the issue up as you will read in here, and the result is we can replace any stainless steel or other structural material within the aircraft, airplane or missile, the difference will be picked up by the Government.

Senator MALONE. I gather from your testimony that right now and perhaps for the next 5 years the Air Corps and the national defense will demand practically all of the available metal. We have private aircraft corporations here who will testify a little later as to their needs. The lighter aircraft is the thing they are all after. In other words, the 25 or 30 percent extra pay load will pay for a lot of extra cost for metal will it not?

Mr. WATKINS. Yes, you are talking on the pay load. That is commercial; we think in armament, of how much farther in mileage range we can carry the fuel for. I could tell you the tremendous savings in one major airplane plant of which I was the manager, in carrying capacity over the pay load in fuel. The fuel consumption in these jet jobs is tremendous, and every gallon means much to us. Any time we can save a pound in weight means more mileage, which I can't tell you because of security reasons. It certainly means the saving of lives and the delivery of that atomic bomb the day it is needed.

Senator MALONE. I think the further thing that they are working on frantically is a practical use of the nuclear energy fuel for airplanes. As you know, there is a submarine to be completed late next year using atomic energy fuel and when it can be used in airplanes, that puts together the two things we were discussing a while ago. That is all of very great interest to this State. If that is all of your statement at the present time, I would appreciate it if you would stand by, especially when the representatives of the Bureau of Mines and the aircraft companies testify. The mayor of Las Vegas is here, Mr. C. D. Baker. We will revert now to the water supply section of this hearing. Will you please come forward, Mayor Baker, and identify yourself for the record?

Mayor BAKER. I am C. D. Baker, the mayor of Las Vegas.

Senator MALONE. I think you are probably more familiar than anyone else with the need for water here. I think you are familiar in a general way with the irrigation bills that have been introduced and the testimony before congressional committees. Some of it was offered by Mr. A. M. Smith, who was then State engineer, in substantiation of the engineering report that was made in 1935, and the irrigation commission that was appointed by the Colorado River Basin States. That report showed that Nevada could use 900,000 acre-feet of water from the Colorado River. I have introduced six irrigation bills in the Senate to use this water together with a map that was made under my direction when I was State engineer, I think made by Mr. Smith, who was working with me at that time. The map is available; the irrigation projects are clear as to location. George Hartman, head of Soil Conservation Survey, testified that they could start work with soil analyses and classification within a reasonable time. Hugh Shamberger, State engineer, has testified that he will assist in the work. It has been my idea at all times that the proj-

ects close to these cities, especially the city of Las Vegas, having a large amount of fertile soil is in this area, should be developed without delay. The work we did in the State engineer's office 25 years ago and the information that we since secured from the Bureau of Reclamation, there are probably from 30,000 to 40,000 acres in this immediate vicinity that could be irrigated, with an 859-foot pumping lift. That would no doubt be very interesting to the city of Las Vegas because it would eliminate the increasing shortage of water in this area. I was very anxious to have you appear before this committee and give you a résumé of your problem so that when this testimony transcript is presented to the Public Works Committee of the United States Senate in January, a part of it will show the necessity, and also the probability of your cooperating in the project.

STATEMENT OF HON. C. D. BAKER, MAYOR, CITY OF LAS VEGAS, NEV.

Mayor BAKER. Senator Malone, the history that you have given is true. In 1935 I happened to be city engineer of Las Vegas. In cooperation with the State of Nevada and the Reclamation Bureau some money was contributed to produce what was known as a curve report. At that time it appeared infeasible, due to the cost of pumping the water. We have wondered several times since then whether or not a review of that report might not indicate whether the financial success of it would be more assured in view of the recent developments. When I was in the Nevada State Senate we introduced a water district bill which would assist in providing water from Lake Mead to Las Vegas. The situation now from a financial standpoint prohibits, due to the possibility of the sale of bonds, the construction of a line that would serve only this area because of the percent of the bonding indebtedness that would be involved in the cost of that line. However, the water district has gotten together with the lessees at the Basic plant and as an interim measure have secured the right to tap onto the waterline there for up to 13 million gallons a day. The plans of Las Vegas as a growing community must be based on the Basic power and water resources that are made available. I see nothing inconsistent with the progress of Henderson and Las Vegas. The introduction of payrolls, employment, and relaxation, if you please, divides the economy of Henderson, Las Vegas, and Boulder City pretty well down the line. The things that people can't get and may not be advisable for within the area of Henderson and Boulder City, they can in a few minutes get here. Many people who are employed at Henderson are living in Las Vegas now. The demand both for the domestic use for the power and water and the demand and the ability to pay for the power and water at an increase over the present rates is here. The markets are here, and it seems only good business that every assistance should be given to devising a proper plan to solve the thing for the future. The outline I have given on the water-district procedure is only a temporary stopgap. The increase in valuations which will be produced by the development of Henderson as a city of its own, and the expansion of Las Vegas and North Las Vegas will create that valuation. We are not paupers asking the Federal Government to give us anything. We have a

market for something, and from a business standpoint I think everyone is able to pay. Possibly steam powerplants and that sort of thing may solve this interim period between the development of additional dams on the river and the atomic reactor. We are in a position now where our growth is handicapped by the lack of the two basic resources and as far as we are concerned we would like, if possible, to have the Bureau's report completed and brought up to date with the increase in the amount of water that we may be able to get. We are not able to use Nevada's share now, but we should secure for the future the additional amount that you speak of. With the growth here, which now seems assured, the testimony not only here but in Henderson indicated that many of the things that are produced there are also valuable in the peacetime economy. I would like for the committee to consider Las Vegas as a part of an aerial development, as a trading center, as an adjunct, and as a cooperator in anything that can be done, both from the standpoint of the industrial development and an economic, developmental Government development and for private industry.

Senator MALONE. That map, while not accurately surveyed, is the best estimate we could make when I was State engineer in 1935 and then the best check that we could get from the Bureau of Reclamation as to location of feasible areas You will note one area of about 35,000 or 40,000 acres by Las Vegas, not surrounding Las Vegas but toward the river and east of Las Vegas. The other project lands are widely scattered. Then, there is a sixth project that was not included in that map at that time but is in a new map, is on the Mormon Mesa, with which you, no doubt, are more or less familiar. You have been an engineer and surveyor in this area for many years and when I was located in Reno. You no doubt are perfectly familiar with all this area. What is needed now, we have reached that point with the bills introduced in Congress, is a soil survey and a land-classification survey. I am only leaving this with you because as you know we both have had rather wide experience in irrigation and flood control and power work. For example on the lower Humboldt River, which was handled by our firm of engineers before I became State engineer, we found that there were not quite enough assets in the 35,000 or 40,000 acres on the lower Humboldt to underwrite a couple of million dollars' worth of bonds, because the value of the land was very low and they had no water. So they took the town of Lovelock in. I am not sure whether they are officially now in the irrigation district or not. But the people of Lovelock were willing to have the value of their property counted in as an asset to back up the value of the bonds, knowing that they couldn't go anyplace if the area didn't prosper, and if the area did, they couldn't lose. I suggest that when we have hearings on this bill that the city of Las Vegas officials be heard. This would be early next year. When water for 30,000 or 40,000 acres is brought into this area to irrigate, it would be a very simple matter to include the necessary domestic water, so that the payments could be divided up. That has been my idea for a long time, and it was not original with me at all. We know we can get more power within a reasonable time from the Central Valley project in California; we have already started with 30,000 kilowatts. That establishes a precedent we can follow through

for more power. Then we have Glen Canyon and Bridge Canyon. I have introduced a bill to build Bridge Canyon Dam. With this amount of power available to us on a firm basis, many believe that instead of 2,500 or 2,600 workers in the industrial area as at present, there will be 4 or 5 times that number within 5, 10 or 15 years. If what we all predict is true regarding the growth of Las Vegas, there will be an enormous number of people who would like from half an acre to 10 acres of land for what we call subsistence homesteads, on which to build a house, where they can raise a few carrots, beets, and potatoes and have a few fruit trees. The cost of water for them can be higher than on regular farms. It is thought that with this program, the land classification and soil surveys which we hope to start within 60 days, that enough information should be available next year to start these hearings. I was certain, knowing as I have for years of your constructive engineering in this area, and now being mayor of the city and responsible, that you would like to enter into this picture.

Mayor BAKER. I think that same type of division, Senator, where that plan was proposed, subsistence homesteads, was brought up in the Kerr report. If the Kerr report was reviewed now it would indicate a much greater demand and a greater ability to pay a proportionate cost on the part of the city of Las Vegas, because with irrigation here we have the same condition generally that applies to Lovelock, although we are a little bit more fortunate in having other payrolls, such as the airbase and we are much closer to everything than is Lovelock.

Senator MALONE. Of course, you are familiar with the briefs I used to write when I was State engineer and Colorado River commissioner, but at that time we didn't have anything here. Everybody thought I was a natural-born optimist, but that growth has been brought out and gone beyond my predictions. Isn't that true?

Mayor BAKER. I think we have something common in that, and the lack of faith on the part of those who weren't able to visualize the future development has probably led to the situation we have now.

Senator MALONE. I think that is true, but now since they see the picture, it is not too late to get this water. I think you are familiar generally with the situation in Arizona and California. They are larger States and make more noise and they are in battles with each other, which sort of throws a smokescreen around our Nevada needs for power and water. Arizona now uses 2,800,000 acre-feet out of the main stream and the tributaries of the Colorado; we use less than 75,000. My remark on the Senate floor was that we were entitled to the next dipper full. My reason for calling you is to help in getting it. One man can't do it alone, it takes the entire area working together to show the need. Now you are familiar with the water table here and I would like for you to generally comment on it, because the State engineer, Hugh Shamberger, testified that in carrying the work forward, starting under my direction in 1935, that they have now an underground water law where they can control or shut down or refuse to issue additional permits to drill wells where the water is all substantially utilized and the State engineer can control the operation of the well.

We had not gone that far at the time I resigned as State engineer because we didn't have enough information. Hugh Shamberger testified that they can do that now and the reason they are not denying

permits and are not shutting down the wells is because they do not want to stop the growth of this area when they are certain that additional water can and will be secured from the Colorado River. However, if the State engineer should be convinced that no more water is coming into this area, it was indicated that new drilling and present withdrawals would have to be rigidly controlled because the water table was reached in 1946, and the use of water here reached a balance between the underground waterflow and the pumping, and from then has been slowly dropping anywhere from a foot to 2 feet a year and now has reached 2 feet or more a year, which of course, indicates that if the supply is not augmented from someplace else within the very near future the water level will fall to the point of uneconomic pumping for anything but domestic use and sewage disposal. The growth of the city would automatically stop. If you would like to comment on that, I would like very much for the record to show what you think about it as mayor and as an engineer.

Mayor BAKER. It is true that the water table is dropping approximately 2 feet a year. The reason the State engineer hasn't seen fit to restrict drilling has been because he was confident something would be worked out between the water district and possibly through Government aid to a point of permitting a drawdown for the interim period before water is brought in from the river. The water district is in the first part of that, but that is only a stopgap. For example, for next year an order has been entered instructing the railroad company to lower its wells that they have now, which obviously will permit a draft of water that last summer they couldn't reach and also will supply additional storage. Tht will do only for the next year or two. As you say, that will only answer the needs over a period of time. The contract that the water district has for only 13 million gallons per day from Henderson is not a permanent solution either. During the summer months, in the city of Las Vegas alone we use between 15 and 16 million gallons a day, and that hardly doubles our supply. With the increase in population the amount of development is now retarded, not necessarily stopped but retarded as to what it could be if we had the proper extensions to water and sewer facilities.

Senator MALONE. Then, don't you find, or haven't you found over the years as an engineer that whenever there is a danger of a water shortage in the future, that prevents industrial concerns from locating here? Unless they are sure of the future water supply they don't come in. That is about the first or second factor an engineer looks into when they send him in to determine whether a factory is feasible or not. There may be many new developments that will come if a permanent water supply can be assured.

Mayor BAKER. That has been the situation we have been faced with here, there has been development within the artesian-wells area, and no provision for assuring industry that would use a great amount of water of a permanent supply and source. We would have to do what has been done principally by local initiative. In the general picture, national defense, development of agricultural lands, mining and other developments here, are going to require more money than we can supply and finance alone. That is the reason why, pending the development of the area to the point of increased valuations, I am certain in my own mind that we won't be able to advance without the technical assistance and possibly the grants in aid that the Government

makes for national defense and for expansion in foreign countries in technical developments and that sort of thing. We should be allowed to participate along the same line. Particularly since the geograpic location is away from the coast, yet having good transportation, good climate, and relatively good labor conditions, we offer something that can't be duplicated in many other places. We also have the space.

Senator MALONE. It has been brought out in testimony this morning that not only the titanium sponge can be produced here but the rolling mills could probably be located here and even the consumers of the metal itself might locate here if they are assured that the water and power supply are adequate. What is the per capita consumption at this time in the city of Las Vegas?

Mayor BAKER. As near as we can tell around 700 gallons per capita last summer.

Senator MALONE. That is rather high, but at the same time when you try to cut down you cut down on a lot of other things in a desert area, like your lawns and various improvements that are necessary.

Mayor BAKER. Of course, there is a peculiar thing there, this being a desert country our per capita cost is high, but I understand the per capita cost in Reno is as much if not a little bit more.

Senator MALONE. They have the same thing there, the water company would like to have meters but nobody wants them because they are afraid it will cut down the use of water for lawns, and it is desert just like it is here only not quite so warm in the summer and not quite so long a dry season. I wonder if you have facilities so you have the force, in your city engineers organization so that could take this so-called Kerr report and brief it for the committee and let it become a part of the hearings. If it could be briefed short enough it could become part of the transcript, and if you could get an extra copy it could be made an exhibit.

Mayor BAKER. We have a very excellent city engineer, you probably know him, he is Mr. C. C. Boyer. His time now is spent in a couple of improvement districts here, but between now and the time your committee meets, I am sure he would be glad to go over the report and bring it up to date, at least from his standpoint engineeringwise, and also supplement it by some comment by the city commissioners.

Senator MALONE. If you care to Mr. Baker, you could take that reprint, it has a map. There are only five projects on it, but the sixth that is included in the additional reprint is far enough away that it wouldn't effect you anyway. It is the Mormon Mesa. You could take that for general information and if you were able to prepare a relatively short brief to be included in the transcript the committee would appreciate it and if you get an extra copy of the report and make some general comments, you could submit it for additional exhibit. Thank you Mr. Baker, for your time. Now we have Mr. Lloyd here, we will return again to the power phase of the situation of the hearing. Mr. Lloyd is Director of the United States Bureau of Mines, Boulder City Station. Mr. Llyod, would you come forward and identify yourself for the record?

Mr. LLOYD. This is Rex Lloyd, I am chief of the Boulder City station of the United States Bureau of Mines.

Senator MALONE. Mr. Lloyd, you heard the testimony of Mr. Watkins this morning who is chairman of a very important committee for the United States Air Force and particularly in charge of the titanium

production. We may have, through my questioning, encroached on your field somewhat, but we are all aware that out of your Bureau has come the practical method of manufacturing this metal and making it available at a very critical time. Whatever you could tell us that isn't classified information, we would like to hear. Classified information we can secure in an executive session later. Can you give us a general progress report on the production of titanium? You heard Mr. Watkins testify as to the waste now. He suggested that some work be done to overcome a large part of the waste. The committee is particularly interested in cost, because when we got into this last year, last summer particularly, I myself went into it because there comes a time when only a United States Senator or Congressman can step into the breach because of the limitations on an employee of the Government. They have the information but sometimes can't supply it without some special permission. We reached a situation last summer, when contracts were lagging in the manufacture of this material. One factor was the high cost, $16 or $17 a pound for raw material. There was difficulty in getting contracts large enough to supply the titanium we knew everyone wanted.

There was some hesitance in letting the contracts until the price came down and the price couldn't come down until they had the contracts and their own operation so it was an awkward situation. There may be other drawbacks, but the committee is not only interested in the present price but what in your opinion as an expert of the Bureau of Mines and knowing more about the progress that is being made then anyone else, where this price might come down to in the event of quantity production, and given a little time in quantity production. You are perfectly familiar with the situation, for the benefit of the record, would you explain it to us.

STATEMENT OF REX LLOYD, CHIEF, BOULDER CITY STATION, UNITED STATES BUREAU OF MINES

Mr. LLOYD. I might say, I am personally familiar only with the work up to the sponge. The work on fabrication of the metal has been done at the College Park Station of the Bureau of Mines. Of course, we know in a general way the results that have been obtained. We might go back to the making of titanium. The Bureau, when Mr. Wartman originally produced titanium metal by the so-called Kroll process, in fact, William J. Kroll, the inventor, for a good many years worked for the Bureau of Mines. This metal was first commercially produced back in 1946. We put out a report on making the metal in 100-pound containers. That was really the first quantity production of metal. Then we started into putting that metal out. At that time we were producing titanium powder—we were not producing sponge metal as you hear about now—we were producing powder and that was being made into sheets and other forms by powder-metallurgical technicians. The Bureau, of course, was interested in getting enough of that out into industry. We thought the possibilities were enormous in titanium metal. Actually sometimes we now feel like we had oversold ourselves. We haven't been able to keep up with the demand for information. Sometime alter, we, as well as other people, went over to the making of titanium sponge. The reason for that is that a lot of the trouble, technical trouble, comes from the fact that titanium metal, in order

to be useful, has to be ductile. In order to be ductile it has to be low in impurities, particularly in oxygen, nitrogen, and iron. The oxygen and nitrogen from the air and water were particularly the elements that effect the hardness. For quite some time, 3 or 4 years at least—I am talking entirely on the Kroll process because the Kroll process is really the only one on which we have most information. Practically all commercial metallurgists now have processes for the manufacture of titanium, most of them electrolytic. We have most information on the Kroll process.

We don't know whether that will be the eventual leading process that is going to win out in the economic race or not. To go back to the Kroll process, 2 or 3 years ago, in order to start some sort of price scale or something to work against, an arbitrary figure was set for the price of titanium by the 2 commercial producers who were then in the field and are still the only 2 commercial producers of titanium—that is du Pont and Titanium Metals—at $5 a pound for sponge metal. That wasn't a price that reflected the cost at that date for producing sponge. It is a figure that was put out as a reasonable price for the type of technology that was necessary. However, that price has stuck with it. It is doubtful up to the present time that anyone has made anything out of titanium sponge at $5 a pound. In fact it has been said, and I think probably accurately, that no commercial company in the titanium business has made any money out of it up to the present time. Everyone is so interested in developing and pushing the development that actually it has been costing them more than they are getting out of it. When we come down to cost, it is a little hard for us, of course, to say what it is going to cost a commercial company to go out here, but we know what it is costing us. We are very anxious, one of our main operations at the present time is to cut the cost of the operation down. That is only one of the objectives but it is one of the major ones, of cutting the cost of making the sponge. We just had an alteration in the new pilot plant constructed last winter which went into operation last July. It is just getting well into operation now. The plant is constructed for a capacity of 1 ton a day. It is not operating at that capacity and it probably won't because the Government doesn't want to produce in competition. It was constructed in that capacity because we want to experiment on titanium reactors of various design and you just can't design a reactor of less than 1 ton per day capacity. We are operating this plant at the present time, at maybe a third of its capacity as a production plant in order to obtain some costs before we go over into some of these new methods. We think maybe some of the new methods are going to cut cost. In other words, we can't tell whether they are going to cut cost until we actually know what it is costing us at the present time. We made up some cost estimates over the weekend, which are not the final word because we have not been operating the plant long enough, but we did make up some costs to show where we are going and probably where this titanium industry can be expected to go, operating on the Kroll process. The estimates we made up—at the present time we are buying titanium tetrachloride and magnesium and the final magnesium chloride is thrown away. Obviously, that is not the most economic operation, but we are trying to concentrate on the actual making of titanium sponge. Our costs at the present time have been brought down to $3.26 a pound of sponge

production. As I say, that is buying our titanium tetrachloride. We realize the price of the commercial product is much higher than it should be, but it has always been a specialty product. It has only been produced by 1 or 2 companies, mostly on an intermittent basis. Both of the commercial producers are now producing their own tetrachloride.

Senator MALONE. In relatively small amounts.

Mr. LLOYD. Yes, in relatively small amounts. Actually all the metal that is being produced commercially, they are producing their own tetrachloride but it is still a very small production. That is where this subject of rutile comes in which I might mention later on. We have also made up some cost estimates, and obviously we don't know as much as the commercial companies that are in the fields. Also, the Bureau of Mines, as you have probably all noticed in the press, have been somewhat criticized for their cost estimates, but here we do have pretty good ground in knowing what we are doing since we have been working on it now for 10 years. We think the Kroll process on a reasonable scale, once the bumps have been ironed out and things got down to a smooth operation, should produce metal in the form of sponge for somewhere around $2 a pound, maybe $2.50, but it will be somewhere in that range. I say the Kroll process, but now everybody has got a process for making titanium. Several companies have electrolytic processes.

Senator MALONE. Would you say this $2 to $2.50 a pound would be in the relatively near future with just a reasonable quantity production?

Mr. LLOYD. That is in the future with present takeage, yes.

Senator MALONE. That foreseeable future would be if they would let contractors take that chance that it is liable to come down perhaps in a year after the quantity machines were installed or some such time after they had completed their plant for quantity production?

Mr. LLOYD. Well, there is a bit of a complication there, one reason why the price hasn't come down with present commercial producers. If we decided as of today that we wanted a plant and were willing to make a 5-year contract for a plant to produce metal by the Kroll process, say on a 40-ton-a-day basis or something, we shut right down on the research at this point and build a plant in that manner with the know-how we have, why yes, in 6 or 8 months after we started operating, in a year the price should be down to there.

Senator MALONE. Do you call a 30- or 40-ton plant an economic size so that you could probably reach whatever economy is possible under the present knowledge?

Mr. LLOYD. With the present knowledge, there is no particular need that we can see in having any bigger plant. That condition, of course, may change any day.

Senator MALONE. The way we have been discussing it has been in 10-ton-per-day units.

Mr. LLOYD. Yes, in 10-ton-per-day units, now just what the economic advantage of 40 tons over 10 tons is I am not prepared to say, it is probably not too great.

Senator MALONE. I expect it would be in the managerial expense and the general overhead as much as anything else.

Mr. LLOYD. Well, there has been one other big expense. Neither we nor the commercial companies nor anybody is happy about the

present cost of titanium. They are striving hard and so are we to develop better processes, and it is this development cost on top of the actual cost that has kept the cost high. In other words, everybody is feeling for a low price somewhere in the future and that has tended to keep the development cost high, rather than accepting the development as it is and building a plant.

Senator MALONE. In other words, they have not settled down on the whole process; you are still hoping to take a short cut someplace.

Mr. LLOYD. Yes, I think the commercial companies, the commercial producers are disturbed and I think perhaps rightly so by the fact that a good many people, including a good many of their own technical men, claim that some of the processes that are on paper or in the laboratories can produce metal at a much cheaper price.

Senator MALONE. In other words the engineers and scientists and laboratory men that are working on this matter in several different locations have been very encouraged and think that they will find a better process, an entirely different method.

Mr. LLOYD. That is correct. We have been doing work on electrolytic processes and are not completely convinced that that is so. However, we can understand the reluctance for them to come out here and spend much money on an expensive process when there may be a cheaper one just around the corner.

Senator MALONE. That has been discussed in the Bureau's reports. I understand that TCA took an additional 10-ton-per-day unit contract, or approximately that amount after or about the time they could see the power contract was going to be signed by the Governor and the Secretary of the Interior for Shasta Dam power to come into the area. In other words, they wanted to be sure of the power before they signed a contract to produce more titanium. If they were to sign a substantially larger contract, or if any other company should do so with this power question hanging over them, and suddenly a new process showed up that reduced costs materially, then, of course, this present process would be abandoned, and there should be something in their contract with the Government that would cover the expense of changing over to a new process.

Mr. LLOYD. They actually have that type of provision in their present contracts.

Senator MALONE. That is necessary due to a prospective transition period?

Mr. LLOYD. That was necessary to get them really to invest the money, the necessary capital, to put that sort of a clause in the contract. One other thing that we are doing some work on and quite a lot of thinking on it is to improve the metal.

I think this isn't answering your question directly, but I think in regard to this idea of the Government stepping in to push something forward much faster than normal development speed, probably the first precedent was the atomic energy development program during the war. The Government always used to let industry take its time, and when it got down to where the Government could get it, they got it. One of the things that has complicated the titanium situation is that they are trying to push a large number of years of development into a much shorter time.

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Senator MALONE. Of course, this threat of war probably brings that about, because if any other nation, thinking of Russia particularly, perfected this metal in quantity production before we do it might be a very dangerous thing. Isn't that true?

Mr. LLOYD. That is correct; we are in, I guess, you might say in the position where we have created a Frankenstein, and once you have created it you have got to keep up with it and assume that other men and other metallurgists are just as smart as ours are.

Senator MALONE. You are right in the middle of this thing. While you may not have had the experience in the industrial end of it, you have seen the various metals in commercial uses. What is your opinion of this metal—we will say not $2.50 a pound but maybe split that to $1.25 a pound—where would that have to come in your opinion to displace iron, steel, and aluminum and other metals in the entire production field?

Mr. LLOYD. Well, it is generally considered that the first point of replacement, when it actually comes to replacing—and, of course, in this day and age we have a lot of things that are not replacements—they are actual matters of new uses. When it comes to actual replacements the first material that titanium will tend to displace is probably stainless steel. That is because of its noncorroding properties and also you might say in cost range. I don't believe any responsible people have yet talked in terms of bringing titanium down competitive to the cost of aluminum, but they have certainly talked, and it looks like at least in the future somewhere—we don't know just where we can grasp it—it will be in the price range of stainless steel.

Senator MALONE. How does it compare in strength and weight with stainless steel?

Mr. LLOYD. It is a little less than 60 percent as heavy as stainless. It is about 60 percent as heavy as steel, and stainless is normally a little bit heavier than regular steel. I believe Mr. Watkins gave the figure of 56 percent. It has the strength, even commercial titanium, has the strength of the best stainless, and in alloyed forms it has strength well above that of stainless steel. So, when you start comparing it with stainless you have some advantages there. That is, you can't just compare it pound for pound, you might say, in the fabricated form.

Senator MALONE. That answers the question that if you pay almost twice as much for the titanium on account of its lighter weight and strength.

Mr. LLOYD. You must remember that when I talk about $2.50 I am talking about the sponge, not about the finished sheet. Of course, the cost of stainless in its finished sheet is much lower, down to $0.50 or $0.60 per pound for the 18/8; however, titanium will mostly replace the most expensive steel. That brings us back to one other problem if you don't mind; it brings us back to one other problem that we are trying to do some work on, which is to increase the uniformity of the metal. That has been one of the big problems in melting and fabrication. We have not only been trying to get the metal uniform but have been trying to get it low in hardness. Too low a hardness is not absolutely necessary but what happens is, as Mr. Watkins mentioned, you make a billet and then you trim the billet, then you make a sheet and put a template (pattern) on it, then you trim the sheet. It has been

difficult up to the present time to save that waste and put it back into the original billet. That is particularly true where you are trying to roll more sheets. If you are trying to make a casting or a forging or something of the sort, you can stand a higher hardness and that is reflected in the price of the metal. It has been difficult to put it back in, so our feeling is that we need softer material, that is, material with lower impurities, material in which we could control the hardness in a very close range as can now be done on steel and other metals. Nowadays when you make a certain type of steel, no matter what type, the range of hardness tolerance is very narrow. With titanium they have had fairly wide. If we get that down to where we can produce soft metal with known uniformity and quality, then we will be in a lot better position to start blending some of this finished product and put the trimmings and scrap back into it.

Senator MALONE. In other words, if you can reach that uniformity in the manufacture then you can begin to save and use the scrap just like scrap steel, put it back into the furnace.

Mr. LLOYD. That is right. As Mr. Watkins said, it took us a good many years to be able to turn stainless-steel scrap back into the furnace. It was considered practically valueless and now a good part of it is going back into the steel furnace and they are handling it.

Senator MALONE. Yes, and in a reasonable length of time the same thing may happen on titanium.

Mr. LLOYD. Certainly it is a point that we have got to work toward because we do have this problem now that if we bring the price of sponge down to $2.50 a pound, and as I say a lot of these processes that are in the mill they talk about $1 a pound. It is still not going to mean much on the overall price if the cost of melting and fabricating is still as high as it is today. All of these things have to work together to bring down the overall cost of the finished product.

Senator MALONE. With the availability of the raw materials, and they seem to be almost unlimited in the earth's surface and available for the manufacturer, and with the perfection of the methods over a few years, there is no reason why these metals that have these certain advantages in weight and strength and other properties, there isn't any reason why they wouldn't displace an enormous tonnage of steel eventually; is there?

Mr. LLOYD. Actually, it is an important metal and will occupy an important spot. We have always had this sort of thing you talk about, you have got to get the price down before the tonnage gets up and we got to get the tonnage and some of the processing improved before the price comes down.

Senator MALONE. It is kind of like the hen and egg.

Mr. LLOYD. Yes, the same sort of a situation. However, not entirely, because there is no question that there is an awful lot to be done in the technology of the titanium, not only in the sponge but the handling of it from there on.

Senator MALONE. Well, Nevada just happens to occupy an important part in both of these discoveries that have improved our position in warfare and will improve our position in peacetime industry and that includes the atomic energy, the explosion of the bombs here and the work that they are doing in Nevada. Now they have indicated, at least a plan is under consideration, to build a commercial atomic

power plant in Nevada. It is just a question of how fast the cost can come down. Both of these discoveries and procedures would almost revolutionize construction and the lives of our people, wouldn't they?

Mr. LLOYD. I think if you were to look back a period of 15 years, all of us can see a lot of things have happened to revolutionize life in almost that much time. Our thinking is completely different than it was 15 years ago.

Senator MALONE. There are a lot of factors that haven't been discussed very much in this atomic-energy field. To begin with, I guess I am the only regular citizen in Nevada, who is cleared for all the information by the Atomic Energy Commission. I realize its importance. My argument was based first on the fact that they are utilizing large areas in our State for experimentation and a lot of our citizens are not very happy about it. They want them to use it all right, but there are many things connected with it that disturb them. For example, I think we are going to get a project at the university, I should say it is ready now, for laboratory work under the biology department of the university to determine the effect of radiation dust on animal life and plant life and water and soil. They all are very learned in their discussions but none of them know the effect. I visited Oak Ridge and went out to the farm where they are experimenting with animals, cattle, sheep, and hogs, and the effect of radiation dust on animals, radiation dust which we have here from our bomb experiments. I convinced them we are very tolerant people here. If anyone was interested in knowing the effect on animal life of radiation dust it should be us. They agreed that they would put in an experimentation laboratory at the University of Nevada. It is agreed upon, it is a question of how much money the university needs and personnel to do it. I also convinced them, this was a couple of years ago, and we have that contract now, that our university should be in the forefront in studies of uranium-ore metallurgy on account of our Mackay School of Mines and knowledge and experience in mining and metallurgy. Dr. Vernon Schied, who is the director of the Mackay School of Mines, is a very competent man, and we know they have a contract to determine new and improved methods of beneficiation of uranium ores. We have some uranium ore here out around Battle Mountain, and no doubt many other places in the State, as they have in Colorado and Utah. The only difference between much low-grade ore now discarded as waste rock and good ore is just lacking a better method of beneficiation. We have convinced them that our Mackay School of Mines is perfectly capable of making these experiments. It will be similar to the development of copper. We used to require a certain fairly high percentage of copper in ore for commercial purposes. Then a smart man by the name of Jackling crawled out of a laboratory one day where he had made one-half of 1 percent copper commercial. Then that useless low-grade copper country rock over in Ely, Butte, Mont., and Arizona suddenly became valuable commercial ore.

That is what we think will happen to a lot of this low-grade uranium ore that we know of now. So we have those two projects. Now I also think I have them pretty well convinced that if they put in a reactor over here, reactor technology can be established in the university

as a course. The equipment would cost about a quarter of a million dollars, which would have to be secured from the taxpayers. But if we have a reactor in Nevada, where we have got this experimental work under way at the university, and where they are using a large area of our State for experiments in bombs, our people would be satisfied that they are not losing something by these experiments but that they are benefiting by the experiments. It would be good public relations, so I really believe they will put the atomic power reactor over at Eureka. Now here we have this titanium setup, right here is the titanium center of the world. You are right in the middle of it trying to improve the process or find new processes and in trying to get the costs down. That puts the State of Nevada right in the middle of all this development if we can keep it. A major purpose of this hearing hinges around the bill that I have introduced to build Bridge Canyon Dam and powerplant. Of course, someone will introduce a bill—I will myself if no one else does—to build Glen Canyon Dam. I have pressed violently for us to take advantage of our "customer preference" clause to secure power from the Central Valley project of California which we are entitled to do just as we are entitled to have a customer's preference clause provision to withdraw power from Hoover Dam, and the future Bridge and Glen Canyon Dams. So, the purpose of this hearing, which I think we will complete today and recess pending submission of briefs, is to do just what you are contributing information about here, determine the practicability of these contracts and demonstrate the need for additional power for national defense purposes and as you have testified, and then working into civilian needs. I am perfectly convinced, that as Mr. Watkins testified this morning and I am sure you have been on the verge of it a time or two, that we are now in a field that is not only national defense but will also be practicable to go ahead with in production for civilian needs. We are not now on a national defense basis alone, as we were with the magnesium down at Henderson, providing we can obtain the power that is necessary looking over the years ahead. There are commercial needs also. Do you agree generally with that?

Mr. LLOYD. There is one thing I might say, I don't know whether it will answer you directly, but I might say that it should be appreciated that when Titanium Metals Corp. came out here and put in their plant, one reason it was put here was because the old magnesium plant was a natural for it. They were practically able to start up. They had their chlorinators, they had their magnesium cells, and furthermore the type of magnesium cells they have here are different than any other in the United States. They are magnesium cells made to handle magnesium chloride which is produced in the Kroll titanium process. So, it was a natural place to come here to start. However, I think you are absolutely right, that whether or not the industry stays here depends on whether or not we can supply the power and other things necessary for the expansion, because certainly the first 10-ton unit is not going to put out the total amount that can be produced. They have a very definite advantage over any other producer at present, because of the integrated process they have out here.

Senator MALONE. You have hit right there the nerve of the whole thing. Mr. Smith of the Titanium Corp. has already testified that if we are not assured permanent power so they could make the invest-

ment and go ahead, they would probably have to move elsewhere for the additional production that is necessary. He then indicated, and I don't think it was a threat, that if they did have to go elsewhere for their production, that this is such a small amount up to now it might all follow. We are not only faced with the lack of expansion, we are faced with the loss of an industry that could become the greatest thing in the world.

Mr. LLOYD. I don't think there is any question in the future of the titanium industry, I think you are correct in worrying more about being able to keep up with the expansion, then we actually should be with the future. Just exactly what the future is going to be from a civilian standpoint is something that concerns the producers as well as us. We are all certain that we can bring the price down, that is no problem whatsoever.

Senator MALONE. That is true. I sometimes think being in the engineering business is a drawback. We do a lot of worrying that nobody else does. I could see this titanium situation coming quite a long time ago and I could see this need for more commercial power, and can foresee uranium energy power coming. It is just a question of whether we profit by it or not. Right now I have two objectives in mind and I know the committee agrees with the first one, the second one might just be my own worry. The first one, we want to keep up with that national defense. We want to quit murdering those kids of ours out there in Korea by losing control of the air; by not having the kind of planes that can whip any other kind of plane in the air. The second thing is: I want desperately to keep any industry here that is just as feasible to be here as elsewhere. Being in the engineering business, and I have been in the business for many years, you know that when an industrial center settles down, one industry feeds off the other. Mr. Watkins testified chlorine goes into the manufacture of titanium, and many other things. It is not easily moved but once it is moved it will not easily be brought back. So while we have it started, now is the critical time. You agree with that?

Mr. LLOYD. Yes; I think this is the critical time and I think this place is a "natural" out here for the titanium business; but there is that worry that you bring up, having adequate power for the purpose.

Senator MALONE. I have been doing most of the worrying, but I hope to get more power. Isn't there another advantage that hasn't been brought out here in manufacturing titanium under the Kroll process? Isn't the low humidity here a real asset in the manufacture of titanium under this process?

Mr. LLOYD. That is correct, under the Kroll process the low humidity is a definite advantage. It may not be in some other process, but in the Kroll process it is a definite advantage.

Senator MALONE. How much time is saved by the humidity here as compared by the humidity in New Jersey where du Pont is operating?

Mr. LLOYD. I don't know that I can exactly answer that question. We have to control the humidity, we have a so-called dry room where we do some of the operation.

Senator MALONE. Yes, but I am talking about quantity.

Mr. LLOYD. If you are in a wet country you have to remove all water to get it down to that point. I don't know that we have any actual figures on cost. There is one thing that happens, too, and that is that

this material produced up to date, so-called sponge, had a very high surface area and it tends to pick up moisture on the surface and if you take it out and store it, or even handle it in wet areas, it tends to pick up a little bit of the moisture, and when you melt it if you are not careful that moisture gets into the metal. I don't know if anyone has ever come up with any figure to show just exactly in dollars and cents how much better it is to have a dry climate but certainly the people who work with it like a dry climate a lot better.

Senator MALONE. I have understood it is quite an item in cost and in the time element. Do you have any further statement to make Mr. Lloyd?

Mr. LLOYD. No; I don't believe I do. I might say we have made a few cost estimates, I mean a few power estimates, since they already know what power is being used out here. I might review those.

Senator MALONE. Yes; I wish you would, if it would not be inconvenient for you to come back after lunch, say if we could come back at 1:45. It is 12:30 now, and I would like to recess until 1:45. Would it be inconvenient for you to come then?

Mr. LLOYD. Not at all; I only have one paragraph, but I will be glad to come then.

A VOICE. Do you want a general statement from us today due to the fact that we will file our briefs later?

Senator MALONE. Yes; I would like to hear a general statement, and then you may submit briefs any time until the 1st of December.

A VOICE. Whatever information you may want, all of us will have to wait upon the Air Force.

Senator MALONE. I understand that. Another thing that has had some influence in recessing this hearing and asking for briefs is that there is a survey under way that will be ready in about 4 weeks, and all of you are entering into that survey. When we first discussed the hearing, which was some months ago, we did not know of this second survey. Perhaps it wasn't even started then. But you had a survey, if you will remember, that was completed a considerable time ago.

A VOICE. Not a very valid one though.

Senator MALONE. Well, we did not know about that, we just thought it was your survey and could be used in the testimony. Now your testimony and the other witnesses' last Friday and Saturday, that is a week ago, and this Monday, reflected that survey more than the new one, although they left it open ended. I have given it thought over the weekend and have discussed it with the committee by telephone, and that is the reason I will not insist on some of the witnesses appearing because they have said that they would rather wait until this survey is out and a brief would then reflect a lot more information than they could give now. I would like a general statement from you and a submission of the brief that you have with the understanding that when this survey has been completed you can then submit another brief and naturally keep away from any classified information, which we can secure in a very short time after this transcript becomes available.

A VOICE. That is the point of my question; I can make a general statement, but I can't present a brief for another 10 days.

Senator MALONE. If you will get here after lunch, we will continue the hearing.

(A recess for luncheon was declared.)

AFTER RECESS

The meeting reconvened at 2 p. m.

Senator MALONE. The meeting will come to order. We have F. T. Wood, Jr., materials and process engineer of Douglas Aircraft, Inc. Would you come forward Mr. Wood and identify yourself for the record?

Mr. WOOD. I am F. T. Wood Jr., chief materials and process engineer, Douglas Aircraft Co.

Senator MALONE. Mr. Wood, you may make your statement in your own way. You have heard the witnesses this morning and you know the objective of the hearing is to determine how best we can get the amount of power we need in time to continue the production of titanium and other national defense materials. It just happens to be that titanium is a hot subject but there are other materials that enter into the production of that metal and also go along with it. I know that you have a hired guard for your company. I know considerable about it. I know you know your business and if you would make a statement for the record for the benefit of the committee it would be appreciated.

STATEMENT OF F. T. WOOD, JR., CHIEF MATERIALS AND PROCESS ENGINEER, DOUGLAS AIRCRAFT CO.

Mr. WOOD. Well, Senator Malone, I can tell you about our commercial airplanes, the military airplanes, but the quantities and the schedules are classified. It has been publicized in the press that in this DC–7 airplane we plan to use about 330 pounds of titanium per airplane. We will need approximately in the neighborhood of 29,000 pounds in the next two years. We have been purchasing the material this year and have some on hand at the present time. So far the usage of the material has, as far as we are concerned, been somewhat slow due primarily to its price and the lack of uniformity of the material that we have had in the past. The expected usage can be high if the price does come down. The parts we have made of titanium that will be part of the DC–7, certain experiment shows that they perform satisfactory. We can use quite a bit of the material in the future, in fact we have estimated that as much as 9 to 12 percent of the airframe weight could be titanium in the near future if the price did come down, and fabricating technics were developed properly.

Senator MALONE. Did I understand you to say that 9 to 12 percent of the airplane weight or the airframe weight?

Mr. WOOD. The airframe weight, that is considerably different than the airplane weight. As an example, in the DC–6 the airframe weight is approximately 20,000 to 22,000 pounds, in that neighborhood someplace.

Senator MALONE. What percentage of the plane would that be?

Mr. WOOD. At the present it represents roughly a fourth of it. It does not including such things as landing gears, seats, engines, powerplants, installations of any kind which account for a great deal of the weight to the airplane.

Senator MALONE. It could include the landing gears and other portions if it were plentiful enough?

Mr. WOOD. That, and if the mechanical properties, the engineering properties, were developed in alloys so it would be feasible to use it.

Senator MALONE. What price, roughly, would it have to be lower to become attractive to your construction, that is, in excess of what you are now using.

Mr. WOOD. That is pretty difficult to say.

Senator MALONE. I realize it is a pretty difficult question, but some range could help us.

Mr. WOOD. Of course, we would like for it to get down to where it is competitive with stainless steel, for example. It is a long way from that at the present time.

Senator MALONE. Of course, in national defense and in the commercial plane, national defense would add to the range or lessen the weight and in the commercial planes it would add to the payload. It would be attractive even if it didn't reach that price, wouldn't it, at a certain place?

Mr. WOOD. That is true, Senator Malone, but it is extremely difficult, as an example, to estimate what a pound of weight in the airplane is worth. A lot of figures have been published. I know that rule as to the pound of weight in the aircraft industry. In general, we think a pound of weight is worth about $20.

Senator MALONE. That is over the life of the plane?

Mr. WOOD. That is right. There are some parts that in the later stages of design of an airplane where the weight becomes more important where you could probably afford to pay more. In the earlier stages of design of an airplane you probably wouldn't be willing to pay as much.

Senator MALONE. There are parts of the plane, especially the engine, that you would just about have to have it for a certain speed.

Mr. WOOD. That is true, yes, to a certain extent. As far as I know the only engines that are using any titanium or propose to use it at the present are jet engines, such things as compressor blades and things of that nature. In the case of most commercial airplanes, in fact all of them, there are no transports available at this time in this country.

Senator MALONE. I notice that in England they are starting to use the jet transport. Is that a good ways away here or is that under consideration?

Mr. WOOD. I think most of the aircraft industries are considering it, but how far away it is is difficult to estimate. The financial gamble, so to speak, is tremendous. It is hard to predict if there will be one and when. The Douglas Co. is definitely thinking of making such an airplane. I know Lockheed and Boeing are also. I would like to correct an impression I think you have, the weight of titanium in a DC–7 airplane will only be 1.6 percent of its airframe weight. I notice you wrote down 9 to 12 percent. This is based on future alloys that are not available to us in quantity at the present time.

Senator MALONE. This 9 to 12 percent would be based on what you hope to do.

Mr. WOOD. Future price reduction and better alloys.

Senator MALONE. What was that percent?

Mr. WOOD. 1.6 percent; it amounts to about 330 pounds. We will purchase approximately 500 pounds of titanium to get 330 pounds.

Senator MALONE. If this comes down to what you consider a com-

petitive price, this material came down to a competitive price, it would probably be utilized in a much higher degree than a 9 to 12 percent.

Mr. WOOD. That is possible, I have heard predictions made where the price could come down to be competitive with that of stainless steel and aluminum and as much as 50 percent of the airframe weight would possibly be titanium. Realizing that some forms of aluminum cost as little as 40 cents a pound, and stainless steel can be had from 60 cents to a dollar a pound it is a long way away.

Senator MALONE. What part of the weight of the plane is in airframe weight in general?

Mr. WOOD. In general terms I would say roughly 25 percent. This will vary, of course, with the type of airplane. I would like to correct that to this extent, that the 25 percent would be roughly one-quarter of the gross weight of the airplane which would include its fuel load, oil, and water.

Senator MALONE. I have seen figures generally quoted to the press that this material might bring about, under favorable conditions, bring about an added 25 percent commercial load. That is a little difficult to arrive at, too, of course.

Mr. WOOD. I don't see how that was arrived at.

Senator MALONE. What is the total load that a plane displaces; what does it weigh in comparison with the weight of the plane?

Mr. WOOD. I don't believe I know.

Senator MALONE. I don't know myself. I was just repeating the press quotings, and I wonder what they were based on. Of course, the payload is much less than the weight of the plane. Is there any further statement that you would like to make?

Mr. WOOD. No, I don't believe so; the aircraft industry, all, of course, is vitally interested in titanium, and we will undoubtedly use it.

Senator MALONE. Yes; I found that out in the last few months when I started to investigate it. Also, your company is in this survey that is supposed to be ready in 4 or 5 weeks. Then there will be certain classified parts of this report that will be available. We will leave this open, recess the meeting instead of adjourning, and insert these briefs, and probably the hearing will be resumed in Washington if it is thought necessary. The objective is to get the best transcript possible before the committee in January. Would you be able to submit a brief giving the committee all the information you could in an unclassified nature indicating as near as possible what remains to become a part of the record?

Mr. WOOD. Senator Malone, would you mind amplifying a little on that? Do you want a general estimate on the part of the Douglas Co. as to the future anticipated needs for titanium based on unclassified airplanes that we might be working on?

Senator MALONE. That is true. Naturally we wouldn't want any classified information because we will get that when the committee goes into executive session, but if you could give us some idea of the requirements for titanium as you see it after this survey over the next 2 or 3 years, 5 years or 10 years, or whatever your survey shows, and let the unclassified become a part of the record, I would appreciate it.

Mr. WOOD. I would like for you to contact the Aircraft Industry Association and the aircraft companies that have just recently participated in such a survey. It must be almost complete by now. I don't believe we could add anything to that.

Senator MALONE. I understand that this general survey would be ready in 4 or 5 weeks.

Mr. WOOD. I would imagine about that time.

Senator MALONE. That not only indicates the commercial industry, the Government is participating in this survey too, I understand. When we discussed this hearing a few months ago we were not aware of that second survey, they had a survey before, which I understand is in much less detail than this will be.

Mr. WOOD. We have completed, I believe, two surveys for Mr. Watkins to date. This present survey I am not aware of. Is this coming from AFRA? I haven't seen that. I don't know if it is the type of information you are after or not; however, I believe this AIA survey would give you a pretty good birds-eye view of what the aircraft people in general usage would be in the next 5 years.

Senator MALONE. One purpose of this survey is to determine what we can do to further the national-defense effort. Of course, I had one other objective, and that is I hate to see this industrial center destroyed or weakened for some reason that could be corrected now and that would be more power. There is a situation, speaking as one member of the committee, that is not helping, there is this certain rivalry you might say between metals. I am not interested in any company. I am not interested in who does it, or what metal you use, just so it is the best metal. We do understand that titanium is the best metal in sight if it can be made available in the quantity you need. You have a situation where the price is so high that it retards the use. It is not likely to come down in price until it is in quantity production. With the expenditure of many billions of dollars abroad, to some of us it seems some of it is being wasted, we would like to see more expended here to see where this thing is headed. If you could make a faster and a better plane for those kids to use out there, I am not much interested in the first cost, especially if it is shown in testimony such as yours, that when you really get into the manufacture of such planes the price would come down and be very reasonable.

Mr. WOOD. That is true.

Senator MALONE. That is the answer as far as I am concerned. I know this: of course, it is true that a Government official is handicapped in breaking through various restrictions and, naturally, companies are dependent upon contracts. Personally, I have no such handicap, and I do not believe my colleagues on the committee have any such handicap. We are in a position to do the right thing. The right thing to do is to get this power and get it in here where the companies like Titanium Corp. can produce this metal in volume and then get the money for the national-defense organizations to let contracts to make these planes and that is what we intend to do, or at least I do, speaking as one member of the committee. Now we know we can get the power. We have the sources, but we have to develop and demonstrate the need. We know the need is there. I want to develop the information to prove the need is there. That is where I need help. I guess you answered my question, and if I understood you correctly it is that 40 to 50 percent of the airplane structure, the airframes, would probably be made out of this metal if the price were adjusted to some reasonable figure.

Mr. WOOD. There are two other things that have a little hand in that, Senator Malone. One is that the material must have a good

service record as far as utility of the airplane is concerned. The other one is that its fabricating costs are not so high, and it is prohibitive to use it. This figure that I gave you would include forgings of all types, airframes, the skin that goes on the airplane, and in order to utilize the material for those applications that so far have not yet been produced the price will have to come down to a very reasonable figure and we will have to have a good service record.

Senator MALONE. Well, if the material proves out like it is indicated it will, the price is the roadblock is it?

Mr. WOOD. That is one of the main things.

Senator MALONE. The price—you heard the testimony of Mr. Lloyd this morning—the price is almost altogether dependent, down to a certain figure, dependent upon production volume. Then we will just have to be in that period, like between dusk and dark when your automobile lights are not doing very much good. We are here now where the national-defense people and perhaps the commercial companies hesitate to spend the additional money that is necessary, yet it is going to have to be expended by somebody to bring the price down. Then the gamble we are taking is if whether or not we do spend the money the price will come down. Personally, if it comes to that, I think there are enough Senators on the Senate floor who would push it right into the stream. We are getting awfully tired, and again I can speak only for one member of the committee, listening to officers out in Korea telling us we couldn't win if anything was started, which everyone knows to be a fact the way we are doing now. I am just as certain as I can be, without the expert experience which you have and many of your colleagues, that these boys can whip anybody if you just give them a good piece of machinery. I am getting tired of seeing them murdered out there. Then will you convey this message to your company, that whatever they can furnish this committee after this survey is completed, this is the 20th of October, say by the 1st of December so they will have time to put it in the transcript by January, will be appreciated.

Mr. WOOD. Yes, sir.

Senator MALONE. We would appreciate anything you can give us. They can indicate, if they will, in that brief the extent of the classified material that we might get in executive session. We will then complete the transcript as was originally contemplated, although it may not be completed as I had hoped on account of this second survey, which we knew nothing about when we discussed it last summer. When did this survey start?

Mr. WOOD. In April this year, and there was another one 2 or 3 months following that that gave some clarification of the first survey, about July. The AIA survey was started in July also.

Senator MALONE. That is just about the time we left Washington. Well, thank you very much, Mr. Wood.

Mr. WOOD. Thank you, Senator.

Senator MALONE. Now we have Mr. F. E. McCreery, who is with the Rohr Aircraft Corp., executive chief engineer. Mr. McCreery, would you identify yourself for the record? You may make any statement you wish.

STATEMENT OF F. E. McCREERY, EXECUTIVE CHIEF ENGINEER, ROHR AIRCRAFT CORP.

Mr. McCREERY. This is F. E. McCreery of the Rohr Aircraft Corp. We are primarily—it might be well to put on the record that Rohr is a subcontractor, and as such our requirements are designated by the contractors. Any briefs that we might be asked to relay to the committee would be a duplication of what the prime contractor would do.

Senator MALONE. Let me ask you—the Rohr Aircraft Corp. would be taking subcontracts from the Douglas and the Boeing and the major companies?

Mr. McCREERY. That is right; at the present time we are primarily engaged in war-plant installations and are manufacturing and/or designing powerplants for about six major contractors, including Douglas, Lockheed, Boeing, Chase, and others.

Senator MALONE. I think that is a satisfactory explanation. Is there any other? Perhaps it would be a duplication, but we do expect to get briefs from the major companies. Is there anything that you would like to offer for the information of the committee that pertains to the general utilization of titanium in the manufacturing of planes and parts?

Mr. McCREERY. I might add, at the moment, we can release the fact that we are presently committed to around 40,000 pounds of titanium on present production orders—that is, military orders for one of the larger bombers—and the rate would be somewhere on the average of 8,000 pounds a month in the year 1953.

Senator MALONE. Is this a new type of plane?

Mr. McCREERY. This is one of the present production planes. The potential—I think it will be expressed only as a matter of opinion on my part—the powerplant in general will contain as much stainless steel per unit volume as any other portion of the airplane. Presently Rohr Aircraft is running twice the tonnage of stainless steel as compared to aluminum for the powerplant manufacture, for which, off hand, you are going to be able to use titanium, and are doing at the moment for materials such as 304 and the nonstabilized stainless steel. The high-temperature-classification stainless steel at the moment, at the present sitting, is not in the picture for a substitution. However, making a rough guess, we would say that on about half of the stainless steel we are running presently on powerplants you could change over to titanium alloy, favorably. The two main things that are concerning us now in the military picture, we are not concerned with the cost, as the military is going to stand behind it, which is one way of bringing the cost down. The next thing is the consistency of the material, which is causing an awful lot of trouble at the moment.

Senator MALONE. What do you mean by that?

Mr. McCREERY. Consistency of physical properties and of sheet conditions will definitely affect the fabrications.

Senator MALONE. In other words, if you are prepared to roll or to use or to fabricate a certain kind of metal and a certain grade of metal, then to have an uneven grade or a different grade not uniform would not only produce a delay but might also make it unsatisfactory.

Mr. McCREERY. That is right. At the present time we are having to segregate the material in order to perform certain fabrication

methods. The welding and the forming, stretching of the titanium, are all pretty well predicated on the constant value of potential strength, ductility, and so forth. That is one of the big things that is holding back, from the material standpoint, the development of fabricating methods. I do feel that within a year you will be in a position to economically fabricate the titanium material from the standpoint of drophammer, stretching, and that sort of thing. Then it boils down to getting consistent material for that fabrication.

Senator MALONE. Do you have any further statement that you would like to make?

Mr. MCCREERY. I would like to go on record—I have gathered from what there was said here—that there was some thought that titanium material was going to be absolutely necessary for your supersonic aircraft, and it is to my knowledge the titanium will only be of value to your supersonic aircraft where you have the problem of fuming nitric acid in connection with your ratio and your higher temperatures. There are stainless steels that will costwise and from a strength-ratio standpoint do the job better than the titanium. I would like to put this on record: In general, the titanium has the possibility of taking the place of approximately one-half of the usage of the stainless steel that we have today. That is the thing that could be in the picture with the cost and consistency and getting down to reasonable figures. It won't replace the stainless steel of today, but it could easily take the place of half the stainless steel.

Senator MALONE. I did have a slightly erroneous idea that the stainless steel would weigh more; therefore, the strength of titanium would make the cost about the same.

Mr. MCCREERY. Well, there are some stainless steels that are better than titanium from a strength standpoint; but, where you have fuming nitric acid, the corrosion problem in connection with that strength-ratio problem, then the titanium takes precedence. There are some stainless—and we can't get away from that in certain applications—that would do the job. Like I mentioned before, I believe that something like 50 percent of your stainless applications today could very actually change over to titanium because of weight saving. I think right now we can say this: the two things that are holding up the titanium program are the cost—I believe the military has seen the way to help that picture, to get that picture on the straight and narrow—and the fabrication problems which are going to be in the hands of the aircraft industries. I think we are progressing very well. We have a drophammer program that is under the direction of the Air Force. We hope to see very good results on that before the middle of next year. With that in the picture as far as we are concerned, the spot welding, the profusion welding, and the welding of the commercially pure titanium should be possible. We want to emphasize that we are talking of commercially pure here and not the alloyed titaniums, because they are definitely more in the background. We feel by the middle of next year we are going to be in a good position for the fabrication of same. When we talk of this 50-percent changeover of stainless to titanium, I, too, would like to go on record in saying that that, too, includes these alloys that Mr. Woods has mentioned that yet have to be developed and yet have a lot of work to be done on them.

Senator MALONE. What is your idea of the volume of this material over the years ahead that would be necessary to keep up with the uses, providing the costs come down within a reasonable range? You have heard us talk about a 10-ton unit per day. There is one contract of that nature here with the titanium corporation, and one has been let, or at least a part of it; but still it is not very much titanium. I had the general idea, and had it from the beginning when this material first became useful, that there is a potentially terrific demand for this metal because there is no scarcity of the raw material. There is more raw material to go into the manufacture of titanium than perhaps any other known metal at the moment. It has more favorable properties. Then, what is stopping it over a period of 10 or 15 years except the price? And the thing that is stopping the price from coming down now is the lack of contracts to go into a volume production and get the bugs out of it. Is that about a fair statement?

Mr. MCCREERY. I think that is a very good statement. We can't make any estimates. I think that again will come out in your brief and in the study made by the AIA which will be presented to you. I have made a rough calculation on the present production which we are now running, which I think, if we talk in terms of percentages and overall tonnage, it probably wouldn't hurt to mention here. Making the assumption that you can change over with other alloys, and this assuming that the material has been developed alloywise, and the military going along with the cost of development, we would estimate around 1,000 tons a year just on present contracts and on present powerplant installations on 5 or 6 of the major prime contractors of the Nation. That is just in the plant that we are operating. Again that would be dependent upon the schedules and that is also now based on the present schedules. I think that is as far as we could go at the moment, but that shows what kind of tonnage you could use today if the material were available.

Senator MALONE. Yes. Of course, you have heard the testimony that this material could go into any moving equipment. For instance, they are flying these tanks in, bulldozers in. If you could cut 30 percent off a bulldozer's weight that you had to fly from here to China or from here to South Africa someplace, you have really done quite a chore.

Mr. MCCREERY. Very definitely; it has a wonderful application in the ordnance field, especially the airborne equipment. That goes right along with the airplane-weight reduction, and the weight reduction in those things carried by the airplane. The material has a wonderful future. We do not want to oversell the fact that it is going to take the place of all stainless, because, even taking place of half the stainless, it has a wonderful future.

Senator MALONE. Well, if it ever did come down to the price of steel, it would take the place of all steel, wouldn't it?

Mr. MCCREERY. Not all steel; that is the point that I was trying to bring out: that there are some steels where the straight weight ratios are still better than titanium.

Senator MALONE. What percentage?

Mr. MCCREERY. I would guess that you are talking about 50 percent of the steel today. No. 1, you can't use the present titanium with the present alloys and the present alloys of the future, thinking for high-temperature application, where you have temperatures of

1,500° or 1,600° or even 1,200°. Titanium presently is limited to around 700° application in service. So, there are stainless steels where we are still going to have to stick with the high-temperature stainless steels.

Senator MALONE. What is the temperature the stainless steel will hold?

Mr. MCCREERY. The stainless steels will hold their strength; the high-alloy stainless steel will hold strength up to 1,500° or 1,600°, and their cooling resistance is also held up to around 6,000°, but they are basically a high-strength alloy in high temperature, which the titanium at the present thinking is not being considered for.

Senator MALONE. I got the idea from a witness—I think it was a Lockheed witness; it was either George W. Papen or an expert from another company—and he has testified—at least so I understood him—that in these supersonic speeds both steel and aluminum lost its strength before the titanium did.

Mr. MCCREERY. There again you are talking in terms of temperatures below the 1,000° mark. I am talking in terms of temperatures over the 1,000° mark.

Senator MALONE. There is something I would like very much if you would bring out in your brief. It seems to me you have a definite place in this picture where you might cover a limited field.

Mr. MCCREERY. We could present that type of information without going into the requirements.

Senator MALONE. I wish you would.

Mr. MCCREERY. I feel that titanium could stand on its own feet without anything blowing it up. I think that titantium has a field and a wonderful field. You can oversell it, but it can't be knocked out from under you just by the overselling. We don't have to oversell it; it is here without the overselling.

Senator MALONE. It is a permanent feature and depends largely on price when you get out of the national-defense field, where we do not let price interfere if it is efficiency we are after.

Mr. MCCREERY. We don't want to call it the wonder material that will do all jobs. We are still going to use aluminum; we are still going to use magnesium, and we are still going to use stainless steel, and you are going to use titanium on top of them. We are not going to replace all other metals with the one metal.

Senator MALONE. But the field that we can cover is clear beyond any production capacity that we can forsee within the next 2 or 3 years, even though we have plenty of power, as I am discussing, and other features.

Mr. MCCREERY. From the figures I have seen published, I will agree with that.

Senator MALONE. What I am trying to do, what the committee is trying to do, and I as chairman am trying to establish, is that the material is needed very badly for both national defense and commercial work, and the only way you can increase the production is to have the power available that it necessary, and the only way you can hope to bring the price down is through volume.

Mr. MCCREERY. I think that is a forgone conclusion.

Senator MALONE. Thank you very much; and, if you care to, if you would tell your superiors that we would appreciate it, to cover that limited field in a brief.

Mr. McCREERY. All right, sir.

Senator MALONE. The 1st of December will allow ample time for it to become a part of this transcript.

(Senator Malone calls Mr. Lamphier.) You may identify yourself and make any statement that you wish to make.

Mr. LAMPHIER. Tom Lamphier, vice president of Consolidated Lockheed Aircraft Corp.

Senator MALONE. You have heard the testimony and objective of the hearing, Mr. Lamphier; so, you may go ahead in your own way.

STATEMENT OF TOM LAMPHIER, VICE PRESIDENT, CONSOLIDATED LOCKHEED AIRCRAFT CORP.

Mr. LAMPHIER. Thank you, Senator. In general, we would agree with the two gentlemen, Mr. Wood and Mr. McCreery, on No. 1, the very definite utility of the metal, particularly when it becomes something we can afford to buy. No. 2, I would like to direct my remarks a little more in the general-range aspects which is concerning you for your particular reason, which is our reason as well. We make both bombers and fighters for the Air Force and fighters for the Navy and missiles for both services, and we also make commercial airplanes. We don't at the moment use titanium, and are not contemplating using titanium in our commercial airplanes, because we can't afford it. Douglas, as Mr. Wood has indicated, is experimenting to a certain extent, and wisely so. In our current programs we are ordering small amounts of it for experimental as well as useful purposes, but we find that, when we discuss using it to any extensive extent in our current production, we run into the—here I am talking about the military again—we run into the case of whether the customer feels he can afford to pay for it. In this case the customer is the Air Force or the Navy, and we find that when we pay over $20 a pound for this material, as a substitute for the stainless steel that we are using, the customer has to think quite a while before he finds himself justified in spending that considerable additional amount of money to gain what small measure of advantage, relatively speaking, he gains in terms of lighter weight. We use it at the moment, for instance, in the firewalls in our engines, also in the areas that these two gentlemen have indicated to you already are the most pertinent at the moment.

Senator MALONE. What temperatures do you find that this material will stand?

Mr. LAMPHIER. I am not qualified to discuss the temperatures.

Senator MALONE. The firewalls would be a pretty high temperature.

Mr. LAMPHIER. Well, not compared with the temperatures at supersonic speeds. As Mr. McCreery indicated, he makes engines for other companies and uses it for that purpose. We would like to use it even more in the future, where we are going into these supersonic speeds you are talking about, for which we have contracts. But we can't contemplate, on long-range basis, using it to any great degree unless we are assured in turn, for our long-range planning purposes, that the Air Force and the Navy are going to be able to afford the production of the materials in the percentages that these gentlemen have been talking about. You are well aware that we have to plan 2 or 3 years ahead for procurement alone of these materials. If we, sitting here

now, take a look at the next 5 years, we can't be too sure of the production of this material, which in turn is translated in the terms of how much power have you got. We then have to make our plans on continuing to use the available materials granted, which are available. So, we are equally interested along with you in the outcome of the surveys that you are conducting here so that we in turn as a company can more inteligently and sensibly plan for the future, even though this stuff might become available 4 or 5 years from now at a considerable less rate. If we know it well ahead of time, we can plan to use it in our designs. We are a party to these several surveys that you have been referring to; and, of course, our specific requirements will be afforded to you through those responses to those surveys. We are equally interested, along with your committee, in the outcome of such a survey so that we, as one element of many other industries, can make some sensible planning for ourselves for this power. As I say, we aren't using any at all at the present time. The simple explanation of the picture, as we see it right now, is we don't plan at the moment to use it at all in our commercial programs and can't foresee when we will, based on the little knowledge we know of future production of this stuff; and, if we are gambling with the Air Force and the Navy in the military fields where the Government money is shared——

Senator MALONE. There are two things there: that, first, it wouldn't be available and, second, maybe the cost wouldn't fit your calculations to be used in a commercial plane.

Mr. LAMPHIER. That is right. In the commercial side it is going to get considerably lower in price before we use it.

Senator MALONE. You are very close to the point that interests me, as one member of the committee, and I am sure it is with the entire committee. Someplace in here Congress is going to have to make the decision, in my opinion, from what I hear all of you say. You are making planes that the Government is buying?

Mr. LAMPHIER. Nine out of ten of the planes are bought by the Government.

Senator MALONE. Yes, and you can't expect the head of the Air Force or the head of the Navy or the head of the Army to buy a plane that costs twice as much, even though he does get away with it. It is not quite fair to him. So, if we could determine what that difference in cost is going to be and what would bring it down fastest and how much of it we are going to need and how much power we are going to need in this center here, which is the center of the production now, and we could be ready with the power when Congress convenes, then that judgment could be exercised by a congressional committee and then on the floor as to whether to say the word or not and back up an Army to go through with it. I am learning a little myself through this hearing, and I have felt for the last 12 months that Congress is going to have to make the decision to make the money available. If in a year or two you didn't make good, we may have to drop back; but the question is whether it is worth that few billion dollars or whatever it costs to find out if it can be done. I believe it is, and I have ever since I began to study it.

Mr. LAMPHIER. As you say, the measure of that decision rests with the Congress.

Senator MALONE. That is where the committee comes in. We can throw this information before the committee so that our technicians can digest it for the committee and have it ready in January as to just what is necessary to do this job, instead of waiting until we get reorganized and get around to hearings which might be April or May and by the time you got the transcripts the year is about two-thirds over and too late. It is a decision to make as to whether to inconvenience men like you to come here and give us the information, but I think it is worth it.

Mr. LAMPHIER. Anything, Senator, that gets us better airplanes sooner is worth it. We are talking about circumstances here that aren't translated into airplanes, but it is an absolute fact that it is Congress' responsibility, along with the services and the people who sell these things to the services, to look ahead a year or two, as our opponents have been doing for quite some time.

Senator MALONE. And, as a result, we are in trouble.

Mr. LAMPHIER. That is one of the reasons we are in trouble.

Senator MALONE. Yes; it is one of reasons we are in trouble, but it is one of the reasons we can correct.

Mr. LAMPHIER. Yes, sir; and it is never too early to start.

Senator MALONE. Of course, I have said on many occasions, when General Vandenberg said we had lost control of the air, from my standpoint—I have been in the engineering business for 30 years and know nothing about your airplane manufacture but know about other methods of building—to lose control of the air in a highly industrial nation such as we are, and with the kind of companies that we know we have—that can do anything if they have the money to do it with and the materials—to lose that control to a second-rate industrial nation takes an expert with experience. We have lost it, I guess. So I, for one Member of Congress, am willing to take my share of the responsibility to cut you loose if it is in the cards, and that is what I want to know.

Mr. LAMPHIER. There is no question about it. I think we could all use this metal as soon as it is available, and particularly if it costs less. If you are going to require more production of this, obviously you have got to have more power. I repeat, Senator, you are talking about something here that has 5 or 6 years' ramification from today. If you don't start talking these days about things, we never will get them done.

Senator MALONE. We have a certain amount of power down here, and there is no more available unless we take it away from another area that also needs it; that is to say, in the Southwest. We are entitled to a part of the power that is being developed in the Central Valley Project. We can build Bridge Canyon and Glen Canyon in 6 to 7 years. In that interim we have to get along, and we can do it. Every year we wait we are that much delayed. Any information that you can give us for the record now that shows what could be done with this metal if you can get it at a reasonable price, or if you had it and were directed to do it with the Government picking up that differential, is important.

Mr. LAMPHIER. The price is important, whether the Government pays for it or we do.

Senator MALONE. It is important, but those kids that are being knocked down in Korea are more important to me than the price,

especially when we are dissipating our resources in a lot of other ways. I am the one who offered the amendment to the mutual-security bill to take the $7 billion and give it to the Air Force, so they could catch up on their knitting before we try to support the rest of the world, and debated it at some length. If anyone is interested in knowing what I really think about it, those debates are available.

Mr. LAMPHIER. I think Mr. McCreery indicated there are at the moment opinions around the lands beyond the scope of what we see for the use of titanium, but there isn't any question but what each of the programs we have for the future includes very definitely this metal to the extent we can get it in a ratio far beyond our present use. But I might say in a ratio that doesn't reach 50 percent in our airplanes as these gentlemen are talking about. I think they will agree with me that what they are talking about wasn't the next 5 or 10 years but the next 15 or 20. This involves a lot of developments in the alloy use of this metal beyond anything these gentlemen are thinking of. We do definitely intend to use it in our programs of the future to a considerable extent, in military programs, that is, and when comes the day that it is something we can afford to buy commercially we definitely will use it in our commercial airplane.

Senator MALONE. Well, a substantial increase in the production of titanium is necessary for your current production.

Mr. LAMPHIER. That is right, at the rate we are using it now in our current production.

Senator MALONE. In other words, here we have contracts let for one 10-ton-per-day unit. I do not know; maybe we are producing half of that, maybe not so much, and maybe a little more. The Titanium Corp. has recently taken another contract. I do not know whether it is a full 10-ton-per-day unit or not, but very nearly so. With those two contracts, and without enough power to consummate the contracts, even if we had the equipment ready, we are not producing as much of it as can be used under current conditions. Is that true?

Mr. LAMPHIER. I don't know, sir. We are; I will speak for our one company's requirements. At the moment we are more or less keeping our requirements to what the Air Force feels we will be able to buy. So I couldn't say how much the excess requirement over the supply exists now. We order what they think in conjunction with the people who are concerned with our program.

Senator MALONE. I will call Mr. Watkins back to answer that question. To put it to you in another way, you can use more titanium than you are getting now in the airplane construction if you know you can get it.

Mr. LAMPHIER. If the Air Force wants to pay the extra cost. And, as I say, the Air Force itself can't say with any ease of mind that they can afford to pay these current prices for titanium for current production uses without some pretty intelligent support from Congress.

Senator MALONE. The only chance of it coming down in price is a greater volume of production.

Mr. LAMPHIER. That is right.

Senator MALONE. Then it still is pertinent to this hearing.

Mr. LAMPHIER. Oh, yes; there is no question about that.

Senator MALONE. We are short of power; we do not have the power here to produce even the volume that has been contracted for and that they have a plant invested for, much less building any new plant capacity, which they would like to do. We have to get this additional power and we have to have power ready and they know it is ready when they pay extra money and the extra plant capacity is available or they simply can't afford to do it. So, the bottleneck is that somebody has to say, "Go." I believe that is the responsibility of Congress after they know the facts. You have testified that at a proper price you need a lot more titanium.

Mr. LAMPHIER. Yes, sir; anything that is as good a metal as this thing is, and apparently is going to be, and weighs much less than does the current stuff we use, wherever applicable is worth using without doubt. We are getting up to the point now where range—as you indicated at the outset—of this metal's usefulness is in the commercial side, but for range and altitude in an airplane anything that we can do to extend the range and altitude of our airplanes these days is obviously desirable since our opposition is building airplanes that will fly farther and higher all the time.

Senator MALONE. The lighter the plane you can build with the same strength and capacity the more maneuverability it will have and the greater protection for our fighter pilots.

Mr. LAMPHIER. That is my measure of a good airplane.

Senator MALONE. If you can just increase by 1 percent the chance of that boy landing alive you have done something.

Mr. LAMPHIER. That is right. The measure of the difference in aerial combat these days isn't sometimes much more difference than 1 or 2 percent.

Senator MALONE. That makes the difference. It is like a roulette wheel; there may be only 1 or 2 percent against you, but if you stay long enough it will get you. I certainly appreciate your coming here. Are you in a position now to prepare a brief, or have your company prepare a brief for the committee following this survey in which you are participating?

Mr. LAMPHIER. Yes, we will give you what we can best estimate to be our requirements, commercially on the one hand and military on the other hand. I repeat that for us to make a good sensible estimate for our own purposes for the next 5 years, we have to work pretty closely hand in glove with both the Air Force and the Navy as to what they in turn think the production is liable to be and in turn how many airplanes they actually think they are going to buy from us beyond giving a rough estimate, beyond the couple of years that we are not contractually certain of. This survey that we are partly contributing to is the one that asks us for our titanium consumption in our 2-year contract. Now what estimates are you making in the next 3 years, is that the next stage?

Mr. WATKINS. I think we will come out with that later but first we have to come out and tell you what to estimate on.

Senator MALONE. My sizeup of the situation when I looked into it was that it was stymied. I also decided that there didn't happen to be any officials in sight who felt like taking a chance.

Mr. LAMPHIER. The Air Force has been, as Roy Watkins has indicated, starting itself and trying to find out. Of course, the industry had already been doing so.

Senator MALONE. They started about 5 or 6 months ago, and I want to help them. I don't want a Bureau official to have to take all that load. I think Congress is dodging its responsibilities if it lets them, but I do not think it has been their fault. I do not believe Congress has been aware of it. That is one idea of this hearing.

Mr. LAMPHIER. Well Senator, this and any other hearing that can devote itself to any aspect of the problem to get more and better airplanes is pertinent to the problem.

Senator MALONE. I have my finger on one sore spot and that is that if you want it you have got to have the power and we haven't got it. We know how to get it and that is one thing that Congress can do. The national-defense organization and your organization can emphasize how important it is so that the people who have it in their power to do this will know they have someone behind them in it. There are too many people involved in it just as there always is in Government affairs. It is not in one man's hands and what we are trying to do in this hearing is to pinpoint it. If it is the opinion that this metal is necessary and that the only way it can be secured at a price where it can be used is to go into volume first and the only way you can go into that volume is to get this power, when we know the sources of power we are getting close to it. I want to say again, I appreciate very much your coming here and your offer to prepare this brief. We will set December 1 as a deadline so as to have time to include it in the transcript. Does that complete the airplane companies' presentation? Now, Mr. Lloyd, we will return to your testimony; we postponed it only because these men must take a plane on time. We will give you an opportunity to complete your statement now.

Mr. LLOYD. You will recall, I just started to say something about power requirements. I might go back a little further on that to explain how the Bureau ever came to get into the titanium business. Normally we are concerned with conservation of natural resources. What happened, and I think this testimony today has very much brought it out—what happened is the fact that a lot of the strategic materials that we would like to have, such as nickel, one of the easiest ways to get more nickel would be to avoid the use of it and that was one of the reasons we went into the titanium business.

It looked like titanium was a metal that would serve the purpose. I think another thing that has not been brought out, and I know you gentlemen are very well aware of, is the fact that when you start making so many thousands of aircraft or something and you set that up against the amount of material available, in some cases some of these critical materials that are going into aircraft there just isn't that much, that is all. So something else has got to be done in these cases. It isn't just a matter of cost sometimes, it is a matter of what you actually don't have. That comes back to what I was going to say about power. Our power-requirement calculations for an integrated plant of the type of the Titanium Metals Corp. is about 17 kilowatt-hours per pound. I don't know just what theirs is running. I think theirs is running a little more than they originally calculated. I think 10 tons was based upon about that figure. In addition to that we are also using, it is running about 5, but it should run about 3½ kilowatt-hours per pound for the sponge installation. That is the

final step in your sponge. We are in a little bit different position in the Government in planning than the commercial companies. One thing they have to do at the present time is to have these big stainless retorts. They are 1½ inches thick, with braces on the inside. From the standpoint of critical materials that is something we like to avoid. In other words, from the standpoint of the Government we don't go out and plan a plant to make titanium that is going to take a big pot of nickel to make it, because nickel is just as critical. One thing we have been doing is to utilize mild-steel retorts that could be heated. The thing principally is the difference between Kaiser's aluminum plant and Kaiser's magnesium plant that was built during the war which took nickel-chrome retorts and the one that was built up in Washington by Union Carbide Co. In other words, by using electrical heating and applying a vacuum on both the outside and the inside, we could avoid the use of stainless steel. So our retorts are made of just mild steel. That creates an extra power cost. It saves nickel, but produces an extra power cost of about 3½ kilowatt-hours per pound. I just wanted to bring that point out because from our standpoint we would like to see them go over to the use of more electric power and cut out the use of nickel from a conversion standpoint. We have just got so much nickel that is available to us.

Senator MALONE. I would say you are crossing quite a bridge whenever you can cut the use of nickel from 15, 20, or 25 percent because it is a very strategic material, and tin is a very strategic material. Do you have anything further?

Mr. LLOYD. No; that was all I wanted to add to that testimony.

Senator MALONE. You have heard the testimony of the aircraft companies of the tremendous use of titanium they will make if the price is somewhere comparable to stainless steel or the Government should make its mind to pick up that extra difference in cost. With your knowledge of this metal, do you agree with that conclusion?

Mr. LLOYD. Yes; one thing we don't know, of course, is what date the price is going to come way down. I am talking below the price I talked about this morning. Everybody is striving to get to that point, where it is going to come I don't know. At the present time the only place you can get more titanium metal is for the Government to pick up the check and underwrite the difference.

Senator MALONE. You talked this morning in terms of $2 to $2.50 in place of $5. Would you let your imagination run for a minute without any commitment at all but just make a general prediction of what might come about if we really went into volume production and allowed you to keep on with your experiments or urged you, and prepared you so you could continue your experiments and the possibility of new processes and all of that. Suppose we looked ahead 5 or 10 years or 15 years, if this metal is what I think it is from what I have heard in the last year, it is going to be with us a long time.

Mr. LLOYD. Yes, we are actually talking about two different things there and I think in order to get the metal that you need at the present time you are just going to have to put a high price on it. However, we are doing lots of research and we hope that present producers are doing research. In fact, practically every major industrial concern in the United States is doing research. Somewhere between the bunch of us, we hope it is us but we haven't got that much pride in the thing

or that much faith, but somebody is going to come up with a better process. I am sure of that. But in research work it is impossible to say whether that is going to 6 months or whether it is going to be 2 or 3 years. If you do, as of today, say that we have got to have a plant producing so much metal then you have got to underwrite the difference. I think this method of approach on the two plans that they have had, where the Government says all right, if it doesn't turn out the way it should be, we will underwrite the cost of the equipment, is a good idea. It is a lot cheaper than underwriting the cost of the metal at a high price. Because when you start even 100,000 tons of titanium at $5 to $10 a pound runs into real money. But if we can say, all right, within a year the process may be obsolete, we will throw it out and put in another process, that is certainly a step in the right direction to getting the thing into operation. I don't think we or the companies or anybody could say today that 4 years from now the metal should be worth $5. I don't think on the other hand they can say it will be worth a dollar. What we have got to do is try to work together and at the same time try to get it down, down, down.

Senator MALONE. Well, we all agree, at least I agree from hearing the testimony, that the more you produce of it the greater the chance of bringing the cost down.

Mr. LLOYD. That is correct. However, titanium is not quite in the same position as some other metals in that way because the present Kroll process is essentially a batch operation.

Senator MALONE. You know what electricity costs and as long as it takes a certain number of kilowatt-hours per unit there is a fixed charge there.

Mr. LLOYD. I don't know of any kind of a plant—we go out here for instance, and are considering a plant for 10 tons, the type of a process that you would even try to develop for a 10-ton plant and the type of process that you would try to develop for a 100-ton plant would be a completely different type of process. We are also anxious to know, and I think we can get a good deal out of such hearings as this, knowing what the objectives are so we can cater processes toward such an objective.

Senator MALONE. You can put it the other way around, if somebody don't take the stuff, if they don't take it directly for the Air Force and the armed services and go into this thing more heavily, or if the armed services don't take the responsibility, it is almost a cinch we are not going to bring the price down within the reasonable future. Isn't that true?

Mr. LLOYD. Of course, you can do a lot of research and somebody may come up here with something new, but I think in order to guarantee use and production we have got to work at it from both directions. We have got to guarantee that we will have the metal and also that there will be enough research done to bring the price down.

Senator MALONE. Let's get at another question. In the history of nearly all products, if it becomes an important enough product, and necessary enough, and enough research is done on it you always come up with something better, or with improvements. Take zirconium. You had to have a metal that would stand a higher degree of heat and Mr. Ralston developed the metallurgy. You may know him as well or probably better than I do and that is pretty well if you do. I think

a lot of him. I have his crew working on a plant out in Oregon. The first thing I knew he had improved a production process for that new metal which has high heat resistance and also resists neutron penetration and therefore made possible a greater degree of experimentation in the atomic energy field. Isn't that true?

Mr. LLOYD. That is correct; they had to have that particular metal and they went after it and got it.

Senator MALONE. They went after it and got it. In other words, it lay there dormant, all engineers knew about it for 30 or 40 years but they paid no attention to it. What I am trying to say is the only approach according to experience, to bring a metal or any other material within the range of customary use, is to make it important enough and emphasize it enough so they really work at it.

Mr. LLOYD. That is right, and of course, there is a tremendous amount of work being done on titanium at the present time. Also when you come to research, something you might say we have first-hand knowledge on, quite often it takes a good deal of work on the technology development before you start showing results. One of the biggest errors you could make, and one we have made not only on research but on other things in the United States, is to push things for a year or two and then just forget about it. Sometimes you are just on the verge then of really getting some results from your money.

Senator MALONE. I think the Bureau of Mines has done a great job over the years. You remember John Coster who finished the job on electrolytic manganese at the University of Nevada.

Mr. LLOYD. I first went to work for John Coster 13 years ago.

Senator MALONE. He had plenty of help, but he spearheaded it. For several years the Bureau had been working at it, and many other people, and John happened to be the one to complete it. It may not be a spectacular thing but it has been used to a certain extent and could become very very valuable in case of an emergency where you couldn't ship in high grade manganese from other countries.

Mr. LLOYD. That is an example of what happens if you don't push things too hard. Of course, in this particular case there wasn't the necessity for it, but Electro Manganese Corp. built their first plant back in 1940. From 1 or 2 tons a day, they gradually expanded it to 10, now they are doubling it to 20. Union Carbide is coming into the picture with a plant. My point is that it takes 10 years or more from the time you start up a plant until you really get a market developed for the thing.

Senator MALONE. Take electrolytic manganese, or zirconium, or this metal titanium, it just seems there is no limit to what we can come up with if we know what we want and the demand is there. Now then, what we need to do, and I think the finger has gone on it in these hearings enough to emphasize the necessity, you have to have some volume of production to get the price down and to do that you have to have power guaranteed before the investment can be made in the plant, so we come right back to the power bottleneck. Isn't that about right?

Mr. LLOYD. Power is certainly one of the things that has got to be considered.

Senator MALONE. If you didn't have it you wouldn't have anything here very long.

Mr. LLOYD. You wouldn't have it here in Nevada, no.

Senator MALONE. That is what I mean. Well, if that completes your statement I certainly appreciate your coming up here Mr. Lloyd. I know you are available at any time, and I know you will cooperate with the committee.

Mr. LLOYD. Yes, sir; we will be glad to furnish any information that we can, Senator, on the subject.

Senator MALONE. If you should think of anything that you would want to submit in a letter or a brief, just do it. Now Mr. Mastin, would you like to make a statement? You may identify yourself for the benefit of the committee.

Mr. MASTIN. My name is M. G. Mastin, my title is engineer in charge of titanium production development section, United States Bureau of Mines, stationed in Boulder City.

Senator MALONE. You have heard the objective of the hearing, Mr. Mastin, and we are perfectly aware of your efforts, we are aware and appreciate the results that you have secured here in the Bureau of Mines. The objective being to know something about, or more about, what quantities of this metal may be used in national defense and the commercial phases of the airplane and other industries. I think the testimony has shown conclusively that in order to bring the price down we must have some quantity production and in order to have quantity production we must have the power to show that the investments can safely be made by the Titanium Corp. and other companies that have to enter into such productions or to take such contracts. The chance we are taking is that if we make that decision to go ahead and go on with the production, what chance is there of the price coming down, not to any certain figure, but just keep coming down to eventually where it would be a competitive price for other materials. If you could give us some idea of your conclusions on this subject, the committee would appreciate it. I know you have given it much thought.

STATEMENT OF M. G. MASTIN, ENGINEER IN CHARGE, TITANIUM PRODUCTION DIVISION, UNITED STATES BUREAU OF MINES

Mr. MASTIN. Well, the question of cost Senator, is divided into three operations, production of sponge, melting of the sponge into an ingot, and the forming of the ingot into useful shapes such as sheet, wire, rod, and so forth. As you know out here in Boulder City we are concerned principally with the production of sponge. However, we also learn from other people who come to see us and from things published in the literature of the tremendous amount of research that is being done, not only under production of sponge but on the melting and fabrication of the metal. It is usually stated that it costs $5 to make sponge and $5 to melt it and $5 to roll it. It seems ridiculous to think it takes as much as $5 to melt metal. I think that will be reduced very considerably as people learn how to handle it. It has been mentioned already today where we have gone into a program here a little ahead of the technology because of the Korean situation and the situation abroad and therefore we are faced with necessity to do things with a new commodity that we don't know about before we are prepared to do it. People tell us that the improvement that is being made in the melting and rolling and in the reclaiming of the scrap from the rolling

process and so on, so that it seems very reasonable to suppose that both of those operations will be brought down to a reasonable cost figure. Now by reasonable I mean indications are that titanium costs can never reach that of steel or nickel, because of the nature of titanium, its ability to absorb nitrogen and oxygen from the air at rolling temperatures, or at fabrication temperatures. It has to be handled a good deal with procedures that are completely unusual in the metal industry. When I say unusual, perhaps from $5 a pound for melting maybe we will get it down to $1 a pound, maybe melting will drop to $1 a pound.

As far as sponge is concerned, it can certainly be brought down below its present market values by a presentable figure. There have been some statements made here today about the cost depending upon the rate of production. I would like to state my own personal opinion on that. Because of the unusual nature of the metal and the way it is made, speaking solely of the Kroll process and not by some other method that may be developed in the future, you can build a plant to make a ton a day at a certain number of dollars, but it costs you almost twice that much to build a plant to make 2 tons a day, or 10 times as much to make a plant for 10 tons a day. The only place you save any money is in the cost of the building that contains the equipment, it might be cheaper per ton to build a 10-ton building than it would to build a 1-ton building and so on. The rate at which your investment drops is much smaller than usual in industry. While there is no doubt an economic size below which one couldn't build, it is nowhere near as sharply marked as it would be in the steel industry and in the nickel industry or something else. Now in my opinion a 10-ton plant will run at the most economic rate if it happens to be the plant that can utilize its crew of labor to the best advantage. If it isn't, the plant should be some other size. A man can do so much work a day, he can tend so many furnaces, or so many retorts or so many other operations. When he has reached his capacity that is peak for him, consequently this estimate that I have prepared of the integrated plant where we can use our magnesium chloride again to make magnesium and chlorine has its labor costs somewhat out of proportion because the plant that I choose as to cost would make 20,000 pounds a month, which is a small plant. That is 10 tons a month. I was forced to use in that estimate figures that are somewhat abnormal in this sense. I assumed you would use 2 men per shift to chlorinate, you would use 2 men per shift to operate your magnesium cells, but those same 2 men could operate 5 or 10 times as much equipment and your labor cost would go down in proportion. Again, they couldn't operate more than their capacity so that at some point you would have to hire more men and wherever that breaking point is will be your most economic plant, in my opinion.

Senator MALONE. That economic breaking point.

Mr. MASTIN. You also talked about the value of power in this operation. Of course, there is no question at all but what if the boys didn't have the power at all in this area they could not operate here for any price, because the power is essential. They would have to go where there is power. I would like to point out that your power cost is a very small part of your total cost. It is something in the order of 5 cents per pound of metal at the prices paid here at Basic. So while it is a very small financial part of your total cost it is really a large

part of the economic aspect. You cannot operate without it. I would like to mention another thing also. It is that your raw material cost, that is the actual cost of the things you buy to put into the manufacture of this metal are also very small, amounting to about 18 cents per pound of titanium. So, that is not an important factor either, and it never can be in this Kroll process. If we use some other process it might be some different figure. If you look at those values, your utilities are low, your raw materials are low, your labor is one of your more expensive items because of the number of hand operations required. I believe the cost of metal could be something in the order of, I would rather say it could be brought down below the $2 figure that has been mentioned here today. Just how far I don't know and how soon I don't know. When you say that you will always have to keep in mind that any day some smart boy may come out with a new process which will make the Kroll process look ridiculous. You can't say when that might happen if it ever does happen. The chances are that it will happen, and it will happen within a reasonable time.

Senator MALONE. There are several companies working on processes.

Mr. MASTIN. There are several hundred expert technologists in this country doing nothing but working on titanium.

Senator MALONE. Whoever comes up with such a process will be very lucky.

Mr. MASTIN. So what we say about the possible lower cost of the Kroll process really doesn't mean too much because I am sure something else is going to come up. In my personal opinion I believe that the metal can be brought down to a point, the fabricated metal where it will be in competition with stainless steel.

Senator MALONE. In other words, it will get into a competitive cost field in a reasonably short time providing laboratory work can continue and there would be additional contracts let for a considerable volume of production.

Mr. MASTIN. I doubt if the volume will make too much difference in cost Senator. I think the point that Mr. Lloyd mentioned a little while ago is much more important, if they would divorce their research work from their production work and tend to their knitting production-wise, then they would bring the cost down to its minimum under the Kroll process. We know that there is a lot of research work going on concurrently with production and in production plants which is not the place for it. That should be divorced from production, then they would have a realistic figure for their production cost. I would like to mention one other point that occurred to me during other discussions, especially when you were discussing the possibility that some airplane parts would be fabricated in this area just because they have titanium in this area. That brought up the thought that perhaps someone might want to make titanium in a heavily populated area.

Senator MALONE. I think I brought that up, but I didn't mean it that way. What I meant was that for security reasons they want to get away from where they are now, and the fact that if power and water were available in the areas where we need further fabricating jobs there would be no drawback to have the plants in the area and complete the work here.

Mr. MASTIN. The only point I wanted to make there was that you do not want to set up to handle titanium tetrachloride in a heavily

populated area, because when that gets loose it drives everybody out. The desert is the place to make titanium tetrachloride.

Senator MALONE. I might say, too, that if such industries come into this area, the chances are from what I have heard and from what I know about the industry, that they would not be located within many miles of the factories for titanium, or its industrial center, especially an airplane factory. From what I know about them they would probably go for 20 or 30 miles from the congested areas providing the water and power could be made available, and it could be, and then you would have more security. I only mentioned that in passing, it is not important in the production of the metal itself, because the freight or the shipments that we have here are not very important either, or in titanium.

Mr. MASTIN. As you know, titanium tetrachloride has been used as smoke by the Navy, smokescreen. I have often thought that if they could just envelope the enemy with it they wouldn't have to shoot them out of the water. The smoke would take care of them.

Senator MALONE. I don't dare get into the discussion of what we are doing out there in the Pacific, I would just get mad, so I had better confine my remarks to the business at hand or I might make a speech. I am very much interested, and the committee will be, in what you and Mr. Lloyd have had to say because it has been a somewhat mysterious metal, it has come in so fast that no one, even a technical person that has not been connected directly with it, has little idea of the progress you have made. It has come to the point now where we are talking about production in volume and it is necessary to have some knowledge of what you have accomplished and what you hope to accomplish in order to exercise this judgment that Congress, it seems to me, must exercise in order to make available the amount of this metal that is necessary in the airplane production both in national defense and commercially.

Mr. MASTIN. I don't think there is any question but what the cost can be brought down to a reasonable figure, but I am afraid we are going to have to wait on technology development.

Senator MALONE. Do you have any doubt, Mr. Mastin, in what you know about the metal and what you have seen it has been used for and the excitement it has caused in industry that it is here to stay and that the market for it will increase in a direct proportion as it becomes competitive. In other words, if it were competitive it would be used conclusively in certain fields.

Mr. MASTIN. I agree heartily, sir.

Senator MALONE. And you do agree, of course, that there is no scarcity of the raw material that goes into it.

Mr. MASTIN. None at all, we have lots in the West here.

Senator MALONE. And there is no particular problem in processing it. My whole point is this, in the use of titanium, there is no question that you have discovered something of incomparable value in national defense and it is a very valuable thing in commercial transportation. The raw material is plentiful in this hemisphere and even in the United States. There just happens to be two things necessary for titanium as a new metal to take its place and displace the use of other metals that can in themselves become scarce. Engineers for two decades have been worrying about high-grade iron ore. While there is no scarcity of iron ore as such there is a scarcity of iron ore that allows

the price of steel to be unreasonable. It would seem to me that this metal has a chance of answering that whole question, because if you cut down the use of steel 40 to 50 percent over the next 10 or 15 years you have solved that problem of the scarcity of iron ore, haven't you? Then you have this atomic-energy power, nuclear energy, that is right on the verge of being in the commercial field. I don't know how much you know about it, but you have heard me talk about it. I am entirely sold on it, getting it started, so that if they can sell power a cent and a quarter per kilowatt-hour considering the production of plutonium as a byproduct, every time they build a plant all the experts, including Dr. Hafstad, who is the commercial powerman of the Atomic Energy Commission, and Gordon Dean, who is Chairman, every time they build one it will cause both power and plutonium to be cheaper. That answers the question of isolated mining camps and water pumping and such in desert areas, two things that are of extreme importance in our own area out here. I am interested in both of them from two standpoints. One of them is the standpoint of national defense, making available these intermountain materials, such as we have at Eureka, Nev., where $150 million worth of lead and zince that are otherwise not available. I am interested in this titanium to make these planes that the boys have to have to regain control of the air. Then, I am interested in the second thing, I know the whole committee is interested in the first point, but I am also interested in the second one, and whenever anything of that nature is as feasible in the State of Nevada as it is anyplace else, I am going to try to keep it here.

Mr. MASTIN. We think it is more feasible here.

Senator MALONE. Then that makes it all the more important. And you will agree too then that, as Mr. Lloyd testified, to some extent the climate here fits the production.

Mr. MASTIN. That is right, if we were to operate this process back East, in the known humidities that we have there, we would not only have to have a dry room such as you saw in Boulder City, the whole plant would have to be dehumidified to some extent.

Senator MALONE. That would be expensive. Yes; I was very much interested in your setup there and I want to come back at the first opportunity and take a real look around. Mr. Mastin, if you think of anything further that would be interesting to the committee I would appreciate it if you would give.

Mr. MASTIN. I might repeat what Mr. McCreery said, this is a wonderful metal but it doesn't fill all purposes. There are other metals that will do things that titanium will not do especially at high temperatures. Nevertheless it is a metal that has so many good properties that it is the coming metal today without any question.

Senator MALONE. In other words, you think it can come near the competitive price, due to the fact that there is no scarcity of the raw materials and due to the fact that we have the facilities to manufacture it, that it could perhaps become the predominant metal.

Mr. MASTIN. It perhaps could be, Senator, if the price got down to where it could compete with steel it might take some of that field.

Senator MALONE. They say there is a terrific commercial field. It doesn't corrode. Farmers' plows and machinery made of it would not require paint. They could be left out in the snow and the rain without being damaged.

Mr. MASTIN. But there will have to be a lot of technology development before that can happen, but it is a possibility, I believe.

Senator MALONE. We certainly appreciate you coming up here, Mr. Mastin. I intend to visit you again at my earliest convenience.

Mr. MASTIN. I am sure you understand that anything we can get for you in the way of further information and so on, we will be happy to.

Senator MALONE. I anticipate you will have an opportunity to testify before this committee again because this is too important to not pursue it for all of the information. Thank you very much.

Mr. MASTIN. Thank you, Senator.

Senator MALONE. Mr. Watkins, in view of the testimony that you have heard, do you have a further statement to make in your capacity as chairman of the committee, with particular reference to titanium for the United States Air Force?

Mr. WATKINS. I have been looking through a few things here that would be unclassified. I heard one of your statements there and I thought perhaps it might be a damn good thing if some more Senators got mad about this Korean situation. I want to congratulate you on that first. Now I want to say a few things here. The Government contracts are written, and we have heard a lot about new processes coming out. Everybody has new processes coming out. I still think it would be a good thing to take it back to the Bureau of Mines and start these boys into research with the different types of process, because they are the ones who came up in the first place, and that is something that only a Senator could do. I am too small a guy.

Senator MALONE. In other words, what you are saying is that these companies are in private research and they are probably very jealous of any advancement that they are making, and for them to turn any basic ideas over to the Bureau of Mines or anyone else to assist in their search would take some persuasion and also some protection if anything comes of it. Because naturally when they work it out themselves it would be a patented process and it would be valuable to them. I know there have been cases and I know you are very familiar with them, where such processes have been worked out and the inventing company has not been given the credit and the benefit.

Mr. WATKINS. The companies have not come up with anything that is of commercial value. As these two gentlemen have said the companies are still in research and development, but they cannot give any ideas out until the thing is done and an agreement is reached with the Government as to what they are going to get out of it, and so forth. On the contrary, the Bureau of Mines will give you any information any time as soon as they find it and it doesn't have to become old and gray before it is used. I certainly think they have done a good job in helping. Now here is something, in August 1952 the Defense Materials Procurement Agency granted an auxiliary tax amortization under certificates of necessity to encourage industry participating in the titanium field. NPA granted a $14,700,000 loan to du Pont to expand its present titanium facility. The agreements included a clause whereby if for any cause the plant becomes obsolete within the next few years the Government will buy it back. That is just to replace the Kroll system. So if something new comes up, the Government will buy it back and replace it with a new process, nobody will be out. We had to do that to get the production of this sponge.

Senator MALONE. In other words, they are protected on any inventions or new laboratory processes.

Mr. WATKINS. That is right. Now, we agreed in 1952, the Defense Material Procurement Agency made an agreement with du Pont to triple the companies output of titanium, which they figure will take 2 years or better, and you know what their output is. Here is one thing you might look into as a Senator on your committee. I am only making a suggestion understand, you are the one who tells me what to do, not me you. But anyone can buy titanium in lots of 20 pounds or less for research or for their private use. Over 20 pounds DO, Defense Order, rating can be obtained, although titanium sponge is under allocation authority, yet there has never been difficulty in obtaining a DO rating. I brought that up in a meeting we had down there and they said I was crazy and they brought in the attorneys and everybody, and they said yes, this is not a critical material and anybody can go up there at any time and take a truckload and dump it if they wanted to, critical as it is. I am only telling you that for your information. Now we are talking on the batch versus a continual process. We would like to see titanium come out like steel comes out, so if you wanted to cut out 1,000 or 5,000, or 500,000 pounds you could do it. They are only making it in little batches like you make taffy, and pour it in a plate, exactly, and then take it out of there and remelt it into something else that you want to use it for. The last gentlemen here were talking about costs, the reduction of costs on quantities. He stopped at the sponge and the melting, but the rolling from there on after you have scalped the ingot and go on, the rolling process is the same as in stainless steel. Here is the trouble I find in going to all the stainless steel people or the ones who are rolling it, or the various people there in this. We would take for instance with 1 airplane company, 1 sheet, 4 feet by 8, another one comes along and they want a sheet 8 by 16. There is no standardization in sizes and they will buy 1 sheet or 2 and by the time a man puts it through the mill the cost is tremendous. At the time aluminum came out I was factory manager for one of the main airplane manufacturers in the United States and the Government, I recall, bought a lot of aluminum and stockpiled it, so as to give the aluminum people a chance to build up on a production basis, and not have to go along job shopping as they are now. They are job shopping the rolling the same as you are doing the batch making. If the Government would come out and say lets stockpile this in the certain grades and sheets in standard sizes of the commercially pure and that our duty is to go around and tell them which these boys haven't been briefed up on yet, that management has the briefing of what we want to go into the airplane. In fact, we have only had 4 weeks to try this, as you know Senator, and we have done a lot in that time. What I mean is, we have still got a long way to go. Perhaps this survey won't be worth much after I get through in the next 6 weeks because I get these plants and tell them they are going to use this titanium and there are no ifs anymore. We go in there and work with them and say, "Here, we would rather have it put in here and put in there," and the last time they had to buy it, this time they don't.

Senator MALONE. If you should order that, if your department should order them to go ahead then all other surveys become obsolete. You have made that decision, which was the purpose of your survey

to start with. That is the decision that I think Congress should help you with.

Mr. WATKINS. Absolutely, and they should help us in this stockpiling. Somebody should think of that, but everybody today is so scared to move that we don't know what to do.

Senator MALONE. That is my point. A Bureau official who thinks anything of his job has got a right to be a little cautious. Most people get used to their jobs, they don't want to be ousted because of a reason they create themselves. Congress—it seems to me that is their duty, that is what they are elected for—should make those decisions after they hear the evidence.

Mr. WATKINS. I am certainly glad to see this committee of Congress in on the top of this, because when I come in with my secret talk it is going to be a good one. Now talking about the low humidity, I could tell you the quantities but I dare not, of titanium sponge that has already been spoiled. These gentlemen know it, it wasn't here in Nevada, it was in another plant. We put it in cardboard packages and sealed them but moisture goes right through back East when you get up to a humidity of 97, and so forth, it goes right through those cartons and we paid $5 a pound for this stuff that these men here admit that they can make for $3. Another thing, they have the uniformity out here in Nevada that we have not had back East. There we have put it under quality control and if the stuff gets up to 120 or 110 we have got to blend it. We have all different sizes going through and you have got a hard spot in one. When you go to form it on the hydro press it don't take the form at one place and at another it will, and they throw the sheet out. As one man said, 50 percent of it was heaved out from another company, not the TMC people. We start our survey, which is actually what the companies would like to have done about 4 weeks ago, this is the first big survey that we have had on the aircraft engines. You must remember, the aircraft engines will be one of the biggest users of this metal and we can explain to you someday why, I dare not here. We are out in the use of encouraging commercially pure so as to get people to handle it. When we first started handling this, people said you can't handle it, you can't pour it, you can't weld it. Now we are doing everything in the world with it. We are starting our school of education there now so that as this man that sat here and that man over there, who have different projects can have an interchange of ideas to know what is going on. In other words, if we find over here that we can weld it with wire we let them know over there, so it is going to increase the use more than these people even think of. This is the only metal, going back to the history of steel and any other metal as these gentlemen have said, that has been sold and oversold before it is made. We are doing in 5 years, as it says here, what we would normally be doing in 25 years. In other words, any metal has been through a slow progress of change.

Senator MALONE. That conforms to the atom bomb and this nuclear energy, perhaps 50 years would have been required if it had not been for World War II.

Mr. WATKINS. I want to say something, I am not a metallurgist, but I have a lot of respect for them. The thing is that all these factories today are operated by metallurgists or Ph. D.'s every one of our titanium manufacturers and people. They are not manufacturers any more

than I am a metallurgist. I am a manufacturing engineer, mechanical engineer and followed airplane designing before I went into the production end, but I don't know metallurgy. Now is the time to take it out of their hands and put it on a production basis in every plant of the TMC or anyplace else and put in managements that understand getting the stuff out of the door, titanium, defense materials, regardless of what it is.

Senator MALONE. That is a good deal like constructing a bridge, the engineer designs the parts of the bridge, but you get a contractor who knows nothing about designing it to build it.

Mr. WATKINS. That is right, you go out and see them with their white coats and all, and doctor this and doctor that, they are not the production people at all. I am only telling you that because of national defense. I am not critizing them, I like them, they are smart fellows, smarter then I am. Now, as we talk about a better process, do you realize that when any new process comes up it will take 2 years to put it into production, to change over? We have got to make the best out of what we have with the Kroll system. If something new—a new process—came out tomorrow, what with the critical shortage of materials and help and all, in new plant layout, we couldn't get into production for 2 years. Let's look at it as what we have today because we can't wait 2 years to get it into production. I told you about the rolling, the labs, and so forth. I don't think you have one thing he meant to bring out. This is very important. There is one factor the other day that came up around here, a big tank of chlorine went up, titanium tetrachloride went up and had that been in the city of Las Vegas, you couldn't have operated, everyone would have had to run to the basement and hide, and things like that. You can't be in a closely confined area, it is perfect where it is now. I think that gives the county something to think of, to zone around that plant. This is one of those things that is bound to happen. It happened to be a quiet day. The gas was released and it went up in the sky higher then a plane can fly. Had that been a windy day and blown around in the community you certainly would have heard from it back in the Senate and probably further than than, somebody would have probably written old Joe Stalin.

Senator MALONE. That is just a further proof that the industry is where it belongs, out here where we are not afraid of atomic bombs.

Mr. WATKINS. I guess that it all, unless there is some question, Senator.

Senator MALONE. Let me ask you this, this of course being the purpose of the hearing, all the detail leads up to that. You have heard the statements made that we do have a preference customer right through the Colorado River Commission, State of Nevada, to withdraw certain power for use within our State from the Central Valley project, and those various dams that are being constructed. You are familiar with the fact that the Colorado River Commission, its Chairman Governor, has signed a contract with the Secretary of the Interior for 30,000 kilowatts in the southern end of the State and 3,000 in the north. You are probably familiar with the fact that we have had certain talks with the Secretary of the Interior in which he has said definitely that he will put allocation of the power from Federal projects on a national-defense basis. In other words, if it is needed for national defense, you will get it. Under that category we will

probably get more power from Shasta Dam. In any case Folsom is coming up, 175,000 horsepower, and we could get a third at least, sixty or seventy thousand kilowatts there. There are other dams coming along, 8 or 10 of them, all available under the customer's preference right. You have heard us discuss the possible construction of Bridge Canyon and Glen Canyon that would make 750,000 kilowatts and 800,000 kilowatts, respectively, available electrical power. You did not hear the testimony of Harvey McPhail. He came 3,000 miles out here as commissioner of reclamation. He is the best powerman in the department, in my opinion, or any department, and has been connected with the development of the Colorado River almost from the beginning of Boulder, now Hoover Dam. He was there when I became State engineer in 1927 and we worked on the passage of legislation in Congress. He testified that with Parker Dam already constructed, Davis Dam already constructed, Hoover Dam already constructed, Bridge Canyon projected, Glen Canyon projected, when completed and coordinated, that all of the power will be firm. In other words, 18 percent of firm horsepower is considered as secondary here now, due to the lack of the regulation of the water. That 18 percent of ours and Arizona's would be more then it now is. All the firm power, and we should get a third of the power generated at those plants if we are able to use it, and it is needed for the purposes for which you and others have been testifying today. Asking your opinion with that background of information, would you say with your knowledge of the advantages of this site to which you have testified and the need for these materials, that these projects should be pressed ahead with all possible speed?

Mr. WATKINS. I have been going to Doty in Washington with all the boys you talk about and giving him the needle for a long time, but they said they couldn't go ahead because of you folks in Congress in the Senate. I have urged from the very start as you see in every report that I sent in to Washington, everyone of these confidential reports have recommended that production be started at once but in the meantime get the power from someplace, I don't care where from, Shasta, or how you are going to wheel it down, that I am not familiar with, but get it now to tide us over to get going. Because if we lose this producing plant here at Henderson, I will say our war production would be set back for years. We absolutely can't afford it, Senator, that thing should be fought out, for many lives may depend upon it.

Senator MALONE. You have made a very strong statement. You are familiar with and have heard the announcement that this will probably be the last hearing of the committee unless there is some witness that might want to be heard here now. We will recess the hearing and allow briefs to be presented up to December 1, so we will have plenty of time to prepare the transcript for the 3d of January when Congress convenes. Would you be of a mind then to recommend to your General Metzger at Wright Field, which is the biggest and most important airfield in the United States, and through your committee, as chairman of the committee of the United States Air Force, would you be willing to recommend to them that they prepare a statement for the Senate committee including those recommendations? The reason I ask is because Congress is made up mostly of laymen with good judgment, men who are used to judging evidence, but unless the

evidence is before them there is nothing much to judge. From my experience of 6 years in the Senate, and of watching Senators operate for 25 years, and I have been an engineer for their committees at different times—I know a Senator has to be selective. He can't possibly cover all the subjects that come before Congress. While I am doing this I can't possibly be familiar with every 1 of 30 or 40 hearings that are going. I am interested in this particular one, this particular subject. Other Senators are interested in hearing about it but haven't the time to familiarize themselves with it. If they see definite recommendations from a national-defense organization or from General Metzger, who is in charge of Wright Field, then they immediately become interested and they read a digest of the testimony and it would, in my opinion, carry tremendous weight. Because as I see it, you can pinpoint it.

We need the titanium, many times as much as we are manufacturing, and we do not have the electric power right now as has been established by Rollin Smith of the Titanium Corp., Fred Gibson of Western Electrochemical Co., and Art Newell of Stauffer Chemical Co.; they do not have the power to utilize all the production capacity they now have. They must have more power. Certainly, as was testified by Rollin Smith, manager of Titanium Metals Corp., before they would invest the millions of dollars that is necessary for additional plant capacity, they must be able to see that the power is going to be available. It has been testified numerous times that the only way the price can come down within a reasonable figure would be to have an economic volume of production. The only way you can have an economic volume is for someone to take a chance on it at the present time. No matter what happens you have to have more power immediately here and you have to have long-range power. Mr. Watkins, I appreciate your being here.

Mr. WATKINS. I am going down tomorrow to a meeting being held in southern California on power, that Jess Larson is going to discuss. Yesterday I went out to Boulder City. Just for my information, it might not be anything to bear on this, but Boulder City is trying to get out from under the wings of the Government. That is a very good thing I think—and put in a city-management form of government. They are using practically all of their 20,000 kilovolt-amperes now. They won't be able to go much further. Without putting anyone on the spot, I believe that Mr. Larson would tell them that if they had more electric power and if we put a little pressure on them, they could produce more sponge. They (the Bureau of Mines) are very good producers of it now, and while the Air Force doesn't get it, or the Ordnance, we don't care as long as it aids the national-defense program. I wanted to see Las Vegas and also Henderson while here but I won't have time. I must leave in the morning. I wonder how close Las Vegas is to its peak; aren't they getting pretty short of power? It's none of my business; they are running their own community out here. If Boulder City is using their full capacity and if it is true that Las Vegas will have to pump more water, they may be in quite a bad fix. I wanted to see the city manager about it.

Senator MALONE. That is going to make it that much worse for us out there. Even if they can secure some temporary power for 2 years or 3 years or 5 years from southern California or Arizona or some-

place that will help this interim period, there shouldn't be any letting up on efforts to get more permanent power from the Central Valley project and these other projects on that account. In other words, if we secure power from the Southern California Edison Co. and the bureau of power and light and from Arizona—some of their share of Boulder power not in present use—and forget about pressing the Shasta power, Folsum power and other sources of firm, permanent power, we might wake up at the end of 3 to 5 years, when prospective temporary sources are shut off, and find that we do not have any power to continue our work here.

Mr. WATKINS. It would have to be permanent power. It should be our power here, in this section. On July 31 there was a big plan to increase titanium production presented at a meeting held in Washington, D. C., by 40 representatives of the titanium industry and 30 from the Government, including the military departments. They reported that potential military requirements of titanium were considerably in excess of the anticipated supply, so the Government figures clear through are showing that we aren't going to have one-eighth of the required suply; therefore, we have got to get increased capacity. Here is one on rutile that I hope you will check into when you go back to Washington. This is for immediate release under Defense Production Administration, and shows the goal for the United States supply of rutile both from domestic and foreign sources has been set at 25,000 tons. About two-thirds of the current supply of rutile is imported from Australia and one-third is domestic.

Senator MALONE. I understand there are certain deposits in the United States, and investigations are under way. Is Mr. Wells here? I guess Mr. Wells has gone home. We will be glad to have a brief from Mr. Wells on the Muddy River situation there, as far as the need for additional water is concerned. That concludes the hearing; we will recess subject to call of the Chair, and probably there will be no more hearings until we reach Washington. We will be open to accept briefs until December 1.

(Whereupon, at 5 p. m., the subcommittee adjourned, to reconvene at the call of the chairman.)

Additional statements received are as follows:

DEPARTMENT OF THE AIR FORCE,
OFFICE OF THE UNDER SECRETARY,
Washington, August 29, 1952.

Memorandum for Mr. Finletter.
Subject: Air Force position on titanium.

Progress in aircraft development beyond 1956 is believed dependent to a considerable extent on the availability of proper materials. There is every indication that metals today will be inadequate in producing the supersonic aircraft of tomorrow. The need for a strong, lightweight metal capable of withstanding the temperatures encountered at supersonic speeds is essential. Titanium will permit the design and production of aircraft to operate beyond the supersonic barrier.

Much progress has been made in the development of titanium in a very short period of time. The problems encountered are basically those resulting from compressing the normal growth of a new metal into a period of a very few years. Present usage of titanium is largely restricted for two reasons, namely, the limited supply in forms and shapes needed by industry, and high cost. As the supply and the demand for the metal increases, a reduction in price will be effected. In the meantime the properties of titanium make the metal so essential for certain applications that the Air Force has adopted the policy of encouraging its contractors to make increased use of titanium by sharing with

them a fair portion of the high cost of this metal. The Army and Navy also have a vital interest in this metal and are expected to become large consumers at a future date when the supply is adequate at an acceptable price. An active and strong Air Force program covering the utilization of titanium will aid in stimulating the industry to increase production, improve its qualities and characteristics of the alloys, sustain the interest of companies presently active in this field, and, as a result, bring about a lower price. Future benefits to the civilian economy are certain to develop.

In the development of methods and techniques for producing titanium, the American industry is exhibiting great imagination. They have devoted considerable sums of corporate funds as well as highly qualified research engineering and production talent to its development. They are rapidly gaining experience in basic reduction methods, improving the size and shape of ingots, and producing basic forms and shapes by known mill methods used in the steel industry. Commercially pure titanium can already be produced in most final forms and shapes.

It is known that ultimately the largest demand for titanium will be for the alloys. By actually adopting in current aircraft the metal produced today, we promote the development of the alloys which are essential to our ultimate needs. It is believed that success in the alloy development area is not far off. The biggest problem facing the titanium industry today is that of producing consistently high quality material in the quantities required and on a regular schedule so that the aircraft industry can adapt titanium to suitable production programs.

Expansion of the titanium industry is now being accomplished through the financial support programs of the DMPA. The Titanium Metals Corp. and the E. I. du Pont de Nemours Corp. are the 2 principal producers of titanium sponge, each having a current output rate of 2 tons per day. Both of these companies are now in the process of expanding their facilities which will result in a plant capacity for each of 10 tons per day by mid-1953. Preliminary discussions have also been held by the DMPA with National Research Corp. and the Crane Co. relative to production of titanium. Other companies which have expressed an interest in producing titanium are expected to shortly make known their positions. The DMPA support to date is based exclusively upon potential military requirements. Although the civilian economy is expected to benefit from the establishment of a titanium industry, rapid expansion through Government support can be justified only on the basis of urgent military needs. The Air Force is supporting the du Pont Co.'s efforts to obtain necessary priorities for steel needed for the construction of its new plant, but to date the Munitions Board had not agreed to sponsor the necessary action with the NPA.

We can expect to encounter further problems in moving forward in the creation of a titanium industry. However, by more effective coordination between the DMPA, the producing industry, the consuming industry, and the military, these problems can be resolved efficiently and the industry established with a maximum of dispatch. Undoubtedly the potentialities of this metal are well understood by our enemies and it is reasonable to expect that they are similarly promoting its development. It is believed that the United States is in the forefront at the present moment in the use of this material, which position we must maintain if progress in aircraft development is to be assured.

ROSWELL L. GILPATRIC,
Under Secretary of the Air Force.

POWER

(a) Requirement for additional power.
(b) Quantities, uses and costs.
(c) Sources of power.
(d) Shasta Dam—Central Valley of California.
(e) Contracts with Arizona.
(f) Contracts with California.
(g) Hoover Dam and Colorado River.
(h) Bridge Canyon Dam, Colorado River.
(i) Glen Canyon Dam, Colorado River.
(j) Steam powerplant, Henderson.
(k) Nuclear power.
(l) Initial procedures.
(m) Production of titanium, uses, demand.

Senator Malone

Outline need for assurance for more power before defense industries
(a) can make new contracts to meet imperatively expanding defense de-
(c) mands for titanium, jet airplane fuel, chlorine, caustic soda, magnesium.
(f) Sources for power, nuclear power may be near, practical now where
(k) diesel generated power is 3 cents per kilowatt-hour as at Eureka, Nev., gives reasons. Eventual coordination of nuclear power with hydro and steam in southern Nevada and California.

Nevada's application for one-third of all power from future hydroplants on Colorado River, particularly at Bridge and Glen Canyons. Contract for 33,000 kilowatts from Shasta Dam. Wheeling contracts and power exchange contracts necessary to deliver to Nevada.

Precedent established for more power from United States sources in northern California, and from Folsom Dam plant when completed; from other plants when constructed.

Flood and silt control on Colorado River to protect existing structures and developments imperative.

Purposes of the hearing repeated.

Harvey F. McPhail, Assistant Commissioner, Bureau of Reclamation

Hoover, installed (1953), 1,367,500 kilowatts.
(g) Davis, 225,000 kilowatts.
(h) Parker, 120,000 kilowatts.
(i) Energy from these 3 dams now all allocated will be from 6 to 7 billion
(c) kilowatt-hours per year.

Power for Henderson is dependent on additional Colorado River developments.

During an interim period, some offpeak power may be obtained from interconnected Hoover and Davis Dam systems, plus whatever Nevada may get from the Shasta Dam allocation.

Future possible withdrawals from the California Central Valley project are possible, since national-defense production of materials including titanium at Henderson is very necessary.

Colorado River from Glen Canyon Dam down through Bridge has potential of about 15 billion kilowatt-hours a year, involving an installation of 3,100,000 kilowatts.

Bridge Canyon 750,000 kilowatts, output from 4.5 billion kilowatt-hours in early years, average about 4.3 billion; decrease to 4.1 billion due to increased use of water in upper basin States.

With Glen and Bridge Canyon Dams and full lower river development, all power would be firm.

Raymond Matthew, chief engineer, Colorado River Commission of California

All new power developments on Colorado River should be set up on same basis as Hoover Dam.

All Hoover Dam and Parker power has been absorbed. The Pacific Southwest has had to install huge amounts of steam electric capacity, 898,000 kilowatts, 771,500 in southern California alone.

By end of 1954, 1,325,000 kilowatts of additional steam electric power planned for installation of which 1,085,000 will be in southern California.

Bridge and Glen will have much fuel oil.

The 15 billion kilowatt-hour potential hydroelectric energy represents 25 to 30 million barrels of fuel oil to produce equivalent steam electric power.

The development of Bridge Canyon definitely planned when Hoover Dam was built has been held up because of the uneconomic irrigation project in Arizona which seeks to tie in the power development.

Bridge Canyon power would probably cost 4½ mills or more per kilowatt-hour, including 50-year amortization and 2½ to 3 percent interest, delivered in southern Nevada, Arizona, and possibly to southern California. There is no more cheap power on the Colorado River.

We are now in the field of 4½- to 5-mill power. The Bureau of Reclamation thinks of selling at around 5½ mills at load center.

There are thoughts in the upper basin storage plan that power developed at Glen Canyon should be reserved chiefly for use and benefit of the upper basin.

This is at odds with the reality of the situation for the power market now and for some years to come would be in the Southwest, that is, southern Nevada, Arizona, and southern California. A proposal to make that power useful only in the upper basin would probably hold up that development, whereas, if authorized along with Bridge Canyon, as has been stated by Senator Malone, the two projects would equalize river flow, provide silt control and together constitute the best possible development of additional hydroelectric power on the lower Colorado River.

Describes location of Glen and Bridge Canyon dams.

(*h*) (*i*) Construction time, 5 years on both Bridge and Glen after funds are made available. Bridge would furnish power as soon as done; Glen would require some time to fill up reservoir for full production—capacity, Glen Reservoir, 26 million acre-feet; Bridge, only 3 million acre-feet.

Samuel B. Morris, general manager, Los Angeles Department of Water, Light and Power

(*b*) Full development of lower Colorado River to 15 billion kilowatt-hours a year would save 25 to 30 million barrels of fuel oil per year (comfirms Matthew's statement), a vital item in national defense.

(*h*) Narrow margins of fuel oil now and we are expanding uses, steam plants.

(*i*) Glen a fundamental necessity to operation of Bridge for silt control and river regulation (confirms McPhail, Matthew).

(*a*) Details steam plants in use and building for Los Angeles.

(*i*) The great markets for power from Glen and Bridge are in the lower basin. Large use by aircraft industry.

(*a*) (*b*) Southern California interests formerly used much of Nevada's and Arizona's power allotment. They have lost this and have had to replace with steam. Cost of oil, $1.80 delivered.

Mr. Peterson, Los Angeles Department of Water, Light, and Power

(*b*) Costs for power at Bridge and Glen should be less than for steam. (Confirm Matthew.) Steam costs vary with old and new plants, and with cost of oil.

Efficient steam plant with oil at $1.80 per barrel would be about 6 mills. Some can be lower, some higher.

The upper basin needs Glen Canyon Reservoir as a regulating reservoir so they can comply with the 75 million acre-feet over a 10-year period. This need will develop in the future. Part of reservoir cost will be paid for by power output by the time it will have regulatory use for the upper basin.

(*a*) (*b*) Southern California has 3,400,000 kilowatts in use. They double use and capacity every 10 years.

Confirms statements made by McPhail and Matthew.

The defense loads cannot be advanced as the sole need for power: all other needs, mostly related, must be included.

The national-defense demand could be estimated, within reason.

Senator Malone

(*a*) The President has said the developments must be on a national-defense basis or be justified by some connection.

Peterson argued that all uses should be considered. Should be put to the Pacific Coast interchange committee which has power statistics. Harry A. Lott, Southern California Edison Co., is chairman.

K. S. Wingfield, administrator, Arizona

Favors Colorado River development for complete multipurpose only.

(*h*) Bridge Canyon project is wholly contained in Arizona, is a natural resource of Arizona, which will need all of the power that can be developed in Bridge Canyon. Arizona has filed an application with the Secretary of the Interior for all the power from Bridge Canyon project.

J. H. Buehler, member, Colorado River Commission of Nevada

All Nevada's Hoover and Davis power allocated 977 million kilowatt-

(*a*) hours per year.

(*b*) Now 400 million kilowatt-hours short of meeting the requirements of Basic magnesium plants alone.

Five major industries at Basic. As they grow, power needs of Nevada's three original contractors will also grow, and need more power than they now have.

A. J. Shaver, chief engineer, Colorado River Commission of Nevada

It has been apparent that we would be short of power since January

(*a*) 1950, when all Nevada's Davis and Hoover was allocated. Now 350

(*b*) or 400 million short.

	Percent
Basic load factor about	85
Lincoln County Power District	80
Overton Power District	40–45

Southern Nevada Power Co. will need 100 million kilowatt-hours more within 5 years.

Major lessees at Basic have contracts for 622 million kilowatt-hours per year.

They (Basic) are 145 million kilowatt-hours short this operating year (1952–53).

Colorado River Commission will have to purchase about 350 million kilowatt-hours for operating year 1953–54.

One lessee requests 125 million more by August 1953. Another wants 138 million more.

Colorado River Commission of Nevada negotiating with California and Arizona agencies for more power, but it would be temporary power, and even so, not enough for all needs.

Colorado River Commission cannot build steam plant. Major lessees may have to do so soon.

Bridge and Glen projects should be hastened.

Some thought given to natural gas.

Steam-oil generated power would raise power operating costs 60 percent over what they are in southern California due to freight for fuel.

(*c*) Colorado River Commission has requested installation of Hoover Dam generator N–8 (82,500 kilowatts) for peaking, standby, and to take a larger share of Nevada's power when water is available. (See p. 162, E. G. Nielsen.)

Considers a steam plant necessary in any case.

(*a*) Use will increase from present need of 977 million kilowatt-hours to 1,007 million by 1996. (See exhibit, a tabulation.)

(*b*) Will amount to about 250,000 kilowatts of additional generating capacity. (The load factors will vary.)

Cannot firm hydropower with additional plants on same stem of a stream. (Note: This seems to be contrary to statements of McPhail and Peterson, who say Bridge and Glen would firm all Colorado River power below.)

Might produce 6-mill power from Utah coal.

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Rollin Smith, general manager, Titanium Metals Corporation of America

(m) Henderson operation is largest in the world and is the only fully integrated plant for producing titanium metal from ores of titanium.

Present program calls for the 10 tons of titanium per day.

Production requires about 15 kilowatt-hours per pound, exclusive of power required to make chlorine, as chlorine is supplied from their neighbor, Stauffer Chemical Co.

They have contract for 151 million kilowatt-hours with Colorado River Commission and a request in for an additional 125 million kilowatt-hours a year.

Their required expansion program calls for up to 275 million kilowatt-hours per year.

Contemplating additional expansion that would require a total of 450 million kilowatt-hours a year.

(m) The great advantage to them and to the Department of Defense which will get most of the product is that by expanding at the basic plant they can bring in the new capacity in about one-half the time it would require starting from scratch in another location.

Four hundred and fifty million kilowatt-hours would be equivalent to about 40 tons of titanium per day, many hundreds of times more than last year's production, but only a fraction of predicted requirements.

Power system into and out of the basic plant has 225,000 kilowatts capacity and could not be duplicated elsewhere in less than 2 or 3 years.

Process they use is the only commercial process yet developed (William Justin Kroll process).

Various new processes in pilot-plant stage. Any of them will require about same number of kilowatt-hours per pound.

Defense requirements are classified. They are a number of times as much as any plans they have now.

The bottleneck for their future investment depends on an assurance of adequate power at a price they can pay for it. Price and reliability are the only considerations.

They are now negotiating for 150 percent expansion on the 10-ton-per-day unit.

Cost of the metal will decrease as production goes up.

Fabricated titanium sells at about $12.50 per pound.

There is a substantial demand for commercial planes, but the military gets the entire output indirectly.

L. P. Spalding, chief research engineer, North American Aviation, Inc.

(m) North American Aviation using titanium in construction of military aircraft and will continue use in future.

Extent of use depends on availability and cost, also on development of improved alloys and experience in the use of titanium.

Quantity used is classified. Declined to discuss in open hearing.

Impossible to give reliable figures on future titanium usage. Depends on congressional appropriations and on decisions of the military services as to types of airplanes.

The designer is responsible for selection of materials, but in special cases, involving use of strategic or critical materials, the recommendations or requirements of the military services would usually be followed.

Because of lack of knowledge as to sources of titanium and its production, he could not state whether additional power was necessary at Henderson.

L. M. Hitchcock, staff engineer, structures, Boeing Airplane Co., Seattle 14, Wash.

(b) Boeing Airplane Co. believe it of extreme importance that development
(c) of titanium and its alloys and establishment of adequate sources go forward on a high priority.

(m) Will improve performance of airplanes and missiles. Details reasons.

Will save 25 percent of weight over many parts now made of steel and aluminum.

Vitally important to military preparedness program.

Boeing Co. recently made a survey which indicates that in the period between 1952 and 1956 about 5 percent of airframe weight will use titanium or its alloys. Beyond 1955 25 percent of airframe weight will be designed in titanium.

Total airframe weight, 1952, estimated 120 million pounds. (Suggests get more accurate figures from Department of Defense, obtainable under property security.)

Airframe weight in World War II in 1944 was 1 billion pounds.

(c) No allowance for scrap losses due to manufacture which will be 50
(d) percent until new know-how will decrease scrap loss.

Probable that reclaiming of scrap loss, when possible will require considerable electric power.

George W. Papen, chief production engineer, Lockheed Aircraft

(m) His job is to develop the best possible airplane for the least amount of money.

Minutes of a National Production Authority conference on titanium state that production will be 8,000 tons per year in 1954.

Not clear whether it will be titanium or sponge.

(m) If the AIA report percentages are used they would require 2,880,000 pounds of titanium for commercial aircraft. This plus military would total 5 million pounds per year. The Henderson plant at 10 tons of sponge per day will give only 6 million pounds of sponge per year.

Lockheed alone would use two-thirds of the total production of the Henderson plant after it sets up to full capacity.

This figure based on 20 percent of airplane weight in titanium. Military and commercial planes will use about the same proportion. Our actual mixed call-outs, military and commercial will require 2,300,000 pounds a year, and this is just for Lockheed Aircraft Co. alone. Within 2 years that quantity would be in use.

Believes that Lockheed, Boeing, and Douglas companies put out about 40 to 45 percent of all airplane poundage.

One plane design worked out requires 471 pounds of aluminum for skin sheeting. If speed is increased to where skin temperature is 200° they would need 530 pounds. With titanium 426 pounds would do.

We want titanium, need it for airplanes for better performance.

Titanium and its alloys vastly important. Lockheed has many men working on it.

Fred D. Gibson, general manager, Western Electrochemical Co.

(a) A letter submitted by Mr. Gibson is made a part of the record, giving important data as to additional power requirements, and savings that would result.

WECCO short 50 million kilowatt-hours at present time.

The 250 million kilowatt-hours additional power referred to in second paragraph of his letter would all be for military uses.

No investment can be made in additional plant needed unless ample power is assured.

(a) The power now being negotiated for by the CRC is not the kind on which they could accept firm commitments of delivery of their products, except for a short time.

Arthur Newell, works manager, Stauffer Chemical Co. of Nevada

(a) Stauffer Chemical Co. operating at Basic since 1945, one of the first there.

Their 1946 power use was 105 million kilowatt-hours.

In 1951 it was 211 million kilowatt-hours.

Probably soon will need 267 million kilowatt-hours in order to supply needs for titanium, and other users.

George R. Bell, electrical engineer, San Francisco office of Federal Power Commission

(a) Federal Power Commission Report on Lower Basin of Colorado River indicated that power requirements for 1960 would be about 31 billion kilowatt-hours and 6,430,000 kilowatts.

By 1970, it would be 40 billion kilowatt-hours and 8,630,000 kilowatts.

Studies made since their 1950 report indicate its estimates are too conservative.

The load growth in the lower basin 1945 to 1950 has averaged about 1 billion kilowatt-hours per year. Will be even greater increase, 1950 to 1960.

Bridge Canyon energy would be absorbed as soon as it becomes available.

Annual rate of energy growth for 6 years ending 1951 is 8.2 percent.

E. K. Albert, vice president and chief engineer, California Pacific Utilities Co.

Company serves five States.

(*a*) Serves Henderson Townsite, Carver Park, and Victory Village.

Have contract for 10,000 kilowatts of capacity and 20 million kilowatt-hours per year.

New housing under construction at Henderson will increase customers 90 percent.

Will soon have power demand 40 percent in excess of their contract. Will amount to 2,000 kilowatt of capacity the first year and 4 million kilowatts per year. The second year, this will be doubled.

They are a part of the basic operations and their requirements will grow with the population. Apparently population will double in 4 to 5 years, so their power requirement will double.

They hope for a share of the prospective Shasta Dam power, also some from Bridge and Glen when built.

Harvey McPhail (testimony resumed)

(*a*) The development of the area will not proceed without greatly increased
(*b*) power. The "long pull" rests in developing the hydro of the Colorado
(*c*) River.

Fifteen billion kilowatt-hours annually is what could be developed below Glen. All would be firm because of integrated river flow and storage.

E. G. Nielsen, director region 3, USBR

(*c*) Work on Bridge and Glen can begin as soon as money is available—some preliminary studies have been made.

J. G. Will, secretary and general counsel, Upper CRC

(*i*) All States of the Colorado River Basin should support Glen Canyon Dam and reservoir as part of the Colorado River storage project. (Statement to be filed, and exhibit.)

Senator Malone

(*a*) Reviews power needs, citing testimony of witnesses who appeared at Henderson.

Speaks of advances in atomic reactor technology and possibility of a reactor being built at Eureka, Nev.

Dr. Lawrence R. Hafstad, Director of Reactor Development, USAEC

(*k*) Details in application of nuclear energy for production of electric power.

Eureka, Nev., considered as a reactor site.

George Hardman, State conservationist, Soil Conservation Service, Reno

Describes duties and field of service.

Would be able to cooperate with other agencies if a program is prepared and approved, so there would be no overlap.

(*i*) Must have a silt detention reservoir above bridge. Glen should be built soon after bridge for silt and regulation, 26 million feet above bridge and 29 million below makes for a beautiful power setup.

Agrees with McPhail that the five power projects on lower Colorado would make all their capacity firm.

V. E. Larson, planning engineer, USBR, region III

Work has been done on the Las Vegas pumping project, the Moapa Valley project and the Fort Mohave project. Most such projects require pumping lifts and are too costly for feasibility under present reclamation law.

Senator Malone

Describes nuclear work in Nevada, and necessity for expanded program.

FLOOD CONTROL

(*a*) Pine and Matthews Canyon Dams.
(*b*) White Narrows Dam.
(*c*) Moapa Valley—Bureau of Reclamation study.
(*d*) Las Vegas Valley.

Horace Miller, Palo Verde Irrigation District trustee

Alamo Dam on Bill Williams River approved by Congress.

Senator Malone

(a) Construction of Pine Canyon and Matthews Canyon Dams in Lincoln County imperative for flood control to protect main-line railroad transportation for defense.

Col. W. R. Shuler, United States Corps of Engineers

All developments on Colorado River are Bureau of Reclamation projects for power except Hoover Dam, for which Army advises regarding flood control.

Flood Control Act approved June 28, 1938, No. 761, 75th Congress. Under this act they were authorized to make survey of Virgin River Basin in Nevada.

Work was delayed by World War II. After the war there was delay in coordinating the work on White Narrows and Meadow Valley Wash.

An interim report covering flood control in the upper basin of Meadow Valley Wash was made. (See exhibit 1.) Pine and Matthews Canyon Dams were then authorized in the Flood Control Act approved May 17, 1950.

Local interests in Moapa Valley decided that more features were necessary in the White Narrows project, and took it up with the Bureau of Reclamation for a new study. In 1950 the civil-works program discontinued work on the Virgin River. Any project, to be continued or authorized must have a high national-defense priority.

Generation of power for national defense or flood control for safety of a national-defense establishment can establish reauthorization.

Colonel Shuler read into the record the specific instructions stemming from President Truman.

A project will qualify if necessary to keep defense plants running with power. Would also qualify to supply industrial and domestic water to a defense area.

(b) Report by Bureau of Reclamation on White Narrows project just received is negative. Reclamation would not repay, annual benefits do not justify flood control.

Note by Alfred Merritt Smith.—Neither Federal agency seems to have considered the major reason for this project, and for which I initiated it while Nevada State engineer. It was to resolve and clarify the water rights between the Indians and the Moapa Valley farmers on the Muddy River. The United States Indian service claimed right to all water in Muddy River, and in times of drought took it all out on pastureland. As a result, ranchers' crops in Moapa Valley were lost. By agreement with the Indian service a division of water was to have been made at White Narrows Dam and measuring devices were to be controlled by the State engineer.

Pine and Matthews Dams thought to be necessary now for defense reasons. He would so recommend, but would not like it stated now as it might embarrass higher authority.

Will report hearing to Chief of Army Engineers and submit data talked of at hearing.

Describes Pine and Matthews Dams in detail. (See exhibit 1.)

Would protect town of Caliente and 13,000 acres of land. Benefit to cost ratio 1.32 to 1.

Will hold hearings as to necessity for Las Vegas Wash flood control. Funds requested for study but were cut. Korean war blamed.

Mrs. Muriel Reynolds, secretary, Las Vegas Valley flood-control committee

(d) She has 40 acres, neighbors have small tracts, desperately need both water and flood control. Her 1 well in 2 years has dropped from 720 gallons per hour to 512 an hour, pumping.

The water is dropping so rapidly that they cannot wait too many years.

Mrs. LeRoy Waggoner, Henderson, Nev.

Presents complaint as to her treatment in the housing program at Henderson.

Housing situation explained by Senator Malone.

Hugh A. Shamberger, Nevada State engineer

(b) Pine Canyon and Matthews Canyon Dams are extremely important for national defense, as Colonel Shuler stated.

(d) Las Vegas Valley houses a great many defense workers. Study of the area should be hastened, also on the Muddy River, also the Mohave project.

IRRIGATION

(a) Available land.
(b) Water requirements.
(c) Depletion of present supply.
(d) Contemplated remedies.
(e) Nevada right in Colorado River.
(f) Malone's irrigation bills.
(g) Subsistence homesteads.
(h) Investigation by State engineer.
(i) Investigations by Bureau of Reclamation.
(j) Studies by Soil Conservation Service.
(k) Studies by Office of Indian Affairs.
(l) Effect on downstream development.
(m) Flood and silt control.
(n) White Narrows Dam and project.
(o) Moapa Valley project.
(p) Mohave project.

Peterson, Los Angeles Department of Water, Light, and Power

(e) The upper basin needs Glen Canyon Reservoir (28 million acre-feet) as a regulating reservoir so they can in the future comply with the provision in the Colorado River compact that they must deliver 75 million acre-feet to the lower basin over each 10-year period. Cooperation should therefore be encouraged for prompt construction.

Senator Malone

(m) Construction of Pine Canyon and Matthews Canyon Dams necessary without dalay to protect defense railroad transportation and crop production in Moapa Valley.

Clair J. Preece, United States Indian service

(n) Indian Service very much interested in construction of White Narrows Dam for flood control and irrigation developments.

(k) Indian Service reserves right to irrigate some 600 acres.

(i) Turned over to Bureau of Reclamation for study. Bureau has declared White Narrows Dam economically undesirable.

Robert M. Parnell, project engineer, Colorado River Reservation, Indian Service

(k) Want to be included in any studies and plans made for use of Colorado River.

(b) Thirty-three thousand acres developed on Colorado River Reservation; potential total, 105,000 acres.

(k) They claim right to water for all. Rights established to 1962, when reallocations will be made.

Hugh A. Shamberger, Nevada State engineer

(a) (f) Soil, land and topographic surveys absolutely necessary in connection with lands included in Senator Malone's land development and irrigation bills.

(b) We should try to determine the amount of water we can use, in order to have a good argument for allocation.

(j) Soil Conservation Service has started work under George Hardman, State conservationist for Nevada. He will study the Las Vegas Valley this winter.

(i) Hope to cooperate with Bureau of Reclamation and Bureau of Land Management for soil studies in Clark County. Good cooperation.

(b) Las Vegas and the valley depends on ground water. The drawdown now exceeds the natural runoff supply and the water table is dropping.

Future of Las Vegas area depends upon obtaining water from Colorado River.

(d) The Las Vegas water district plans to buy the water supply facilities of the Las Vegas Land & Water Co. A bond election will be held late this winter to raise $7,500,000 to buy out the water company and also supply money to construct a pipeline from the present Lake Meade-Henderson pipeline into the city of Las Vegas.

Senator Malone (chairman)

(g) Recites details of necessity of small acreage homesites.
Subsistence homesteads.

Hugh A. Shamberger

(j) George Hardman, Soil Conservationist Service, plans to start Las Vegas Valley surveys this winter (1952–53).
(j) Aerial surveys needed to expedite work on Morman Mesa and other
(h) areas.
(c) United States Geological Survey in cooperation with the State engineer in 1935 made study of Las Vegas water situation—report published in 1949. (See exhibit.)
Limit of safe yield was reached in 1950. In 1951 depletion was between 6,000 and 8,000 acre-feet above the safe yield. Will be more in 1952.
Water table receding at rate of 2 to 3 feet per year. (Confirmed by C. D. Baker, (h) 219.)
Date as to drawdown given.
(c) Although depletion of water supply at Las Vegas had set in, State engineer Smith agreed to allow permits to drill after the city and county agreed to form a water district to bring in additional water from Colorado River. (Discussion and questions as to the economics by Senator Malone.)

T. W. Robinson, Staff Engineer, Water Resources Branch, United States Geological Survey, Ground Water Division

Confirms testimony of Hugh Shamberger relowering of water table in Las Vegas area and adds details resulting from study. (See Bulletin No. 5, an exhibit.)
Unless water is brought to Las Vegas from Colorado River, future growth will eventually be prevented.
The present draft on ground water is greater than the supply from the limited precipitation.

J. W. Odell, Surface Water Branch, United States Geological Survey, Salt Lake City

United States Geological Survey has system of gaging stations on Colorado River, several on Muddy River; 3 on Muddy River and 1 on Meadow Valley Wash.
Records of suspended sediment are collected by the United States Geological Survey.
Dams upstream would stop deposition of sediment in Lake Mead to a certain point.

Senator Malone

Describes irrigation bills he has introduced, S. 1297 to S. 1301, inclusive, and another bill later, covering Mormon Mesa, Clark County, Nev.

Edwin G. Nielsen, director, region III, United States Bureau of Reclamation, Boulder City

(c) Colorado River only practical source for additional water for Las Vegas area.
(d) Nevada does not now use quite as much as 75,000 acre-feet.
Region III funds committed for this year, but they will cooperate so far as possible with State engineer and other agencies.
Any change in program must be presented to Congress.
Some change of program can be made by the Commissioner of Reclamation but he is reluctant to make changes, but changes have been made in their investigation program.
(f) The sponsoring agency is asked to pay 50 percent of the cost of
(g) investigations. (Appropriation act.)

(*i*) If the State engineer requests a survey and expended a certain sum of money, the Bureau would spend a similar sum, provided, that the work of the State engineer or other cooperating agency's work was in furtherance of the Bureau's work, or vice versa.

Soil conservation work could not be matched, the Bureau can't match Federal funds with other Federal funds.

(*i*) Complete investigations in Nevada on the Colorado River, covering 6 or 7 different elements, if programed with the continuing investigations in other Western States probably would string out for 15 years.

Discussion as to work done in Arizona.

If money and personnel is made available some of the Nevada projects could be disposed of rather quickly.

A reconnaissance survey of Nevada lands under consideration was made by Fogerty (?) at the Washington office, who was in charge of land classification in the Colorado River Basin while stationed at Denver. He made a rather thorough survey.

Senator Malone

(*f*) Three thousand men working in area now. Many more will come if power resources are made available. Many times that number may eventually come. Small homesite farms, from 1 to 10 acres, are highly desirable, so-called subsistence homesteads.

Congress does not now require any guaranteed payment ahead of construction.

(*i*) Reference to procedure at Rye Patch Dam, Nev.

George Hardman, State conservationist, Soil Conservation Service, Reno

(*j*) Describes duties and field of service.

Would be able to cooperate with other agencies if a composite program is prepared so there would be no overlap.

Where public and private lands intermingle, work is done on the private lands also.

Will begin work in Las Vegas area almost at once. Must be within an organized soil-conservation district.

(*f*) As to lands covered by the Malone bills, would first get an aerial survey. Such surveys have been made and can now be bought from the United States Geological Survey.

(*j*) Describes methods of surveys and study.

In small areas, given water and power, you can almost make any land into what is desired.

They can to some extent determine costs. They help the farmer develop his own farm program.

Would have a crew present to help the farmers over several years.

Describes organization of soil-conservation districts.

Associated with Farmers' Home Administration. FHA is limited to $100,000 loan on a single project, which is too low for this territory.

E. G. Nielsen (testimony resumed)

(*i*) Would first examine the whole irrigation potentiality and be satisfied that the expense of a land classification is justified.

(*o*) Bureau of Reclamation completed a survey on the Moapa Valley irrigation project. The Muddy River Irrigation Co. plus the Indian Reservation could repay in about 100 years.

(*h*) Fort Mohave project completed subject to review by the chief engineer and commission—a pumping project covering 1,600 acres.

Pretty small, might be handled by private enterprise rather than by the Bureau of Reclamation.

Discussion with Senator Malone as to amortization period; 68 years is longest yet approved.

(*c*) Depletion of water a real danger. Has happened in other districts.

Senator Malone

(*f*) A man with 2 acres can afford to pay 10 times as much for water as one with 160 acres. States reasons.

V. E. Larson, regional planning engineer, region III, United States Bureau of Reclamation

Arizona Central Valley project was recommended, with no possibility for repayment.

Bureau has no preconceived ideas as to Las Vegas Colorado River development.

Senator Malone

Tell how National Reclamation Association saved the Bureau of Reclamation in 1932.

V. E. Larson

First necessary to determine the cheapest way to supply water.

(f) New additional power a factor for it would influence growth. It would be considered in study.

Senator Malone

Discussion as to Grand Coulee project.

Asks consideration for Nevada, expenses being equal or less, as well as for Arizona and California, and other projects.

V. E. Larson (continued)

(f) The Bureau will make the same kind of studies on the lands covered by Malone's six projects as they have made on Moapa and Mohave, and will make in Las Vegas Valley.

Horace Miller, president, board of trustees of Palo Verde irrigation district

Read a prepared statement, pages 177–178. District had bill in Congress last session for a canal from Headgate Rock Dam through the Colorado Indian Reservation in Arizona with siphon under the river to Palo Verde Valley. Bill delayed, died in committee. Palo Verde irrigation district will introduce a similar bill in January or February 1953. Will cancel wier, increase power at Headgate Rock Dam. The Indian Reservation and Palo Verde irrigation district also interested in construction of Alamo.

Dam on Bill Williams River proposed by Corps of Engineers and approved by Congress.

No additional water use or diversion intended.

John M. Finley, county agent, Clark County University of Nevada, and Clark County Agricultural Extension Service co-op under United States Department of Agriculture

Described work, agricultural work and leadership.

Suitability of various types of grass and plants studied. Las Vegas area, Moapa Valley, are adapted to profitable, uncommon crops for seeds and transplants. Land very valuable, can carry big expense load. Cites tomatoes, alfalfa seed, etc., in Moapa Valley.

C. D. Baker, mayor of Las Vegas, Nev.

Reviews Las Vegas water situation.

Not able to use Nevada's full share of water now, but it should be secured for the future.

Soil and land classification surveys needed.

Kerr report made by Bureau some 15 years ago should be reviewed, which will show greater demand and ability to pay for water now.

(d) Union Pacific Railroad Co., parent company of the Las Vegas Land & Water Co. has been ordered to lower its wells for greater draft for supply and storage, but that will only do for a year or two.

Contract with Las Vegas Water District for 13 million per day from Mead Lake is not enough. Las Vegas city alone uses some 16 million gallons per day in the summer. Use is about 700 gallons per capita.

ELECTROCHEMICAL INDUSTRIES, HENDERSON

(a) Western Electrochemical Co.
(b) Stauffer Chemical Co. of Nevada.
(c) Pioche Manganese Co.
(d) Manganese, Inc.
(e) Titanium Metals Corp. of America.

Western Electrochemical Co.

(a) Letter by Fred Gibson, general manager, details products manufactured and power needs.

Mr. Gibson explains his need for more power in order to expand plant and take new Government contracts for military supplies.

Arthur Newell, works manager, Stauffer Chemical Co. of Nevada

Describes products which include chlorine, caustic soda, DDT insecticide, benzine hexychloride, muriatic acid. Chlorine used on project in making titanium. Caustic soda at plant but mostly on the Pacific Coast by oil companies, for aviation gasoline, soaps and detergents. Muriatic acid used in titanium production also in northern Nevada to recover tungsten.

F. A. McGonigle, general manager, Manganese, Inc.

Just completed large new plant at 3 Hids mine near Henderson for
(d) production of manganese dioride nodules from manganese ore.

Have firm contract for 6 million kilowatt-hours per year with Colorado River Commission. Annual need is for 18 million kilowatt-hours.

Small power user, but important production. All manganese produced sold to General Services Administration.

Twenty to thirty tons of lead per day is produced as a byproduct.

Fear they may have to depend on sources of dump power from Hoover and Davis Dams.

With Russian imports now cut off our needs for manganese are critical.

Recites in detail manganese situation in United States and world.

Plant designed to treat 1,200 long tons of ore per day.

Richard W. Lottridge, general manager, Pioche Manganese Co., Henderson

(c) Pioche Manganese Co. is subsidiary of Combined Metals Reduction Co.

Have now contract for 10,200 kilowatts. In their use, it will supply 75,500,000 kilowatt-hours per year.

Need an additional 5,000 kilowatts of capacity, or 35 million kilowatt-hours more now.

Their future planning and program calls for 22,700 kilowatts and 168,500,000 kilowatt-hours—double what they have now. Energy is not available now. Cannot expand without the power.

Even now they are depending on "sufferance" energy—off peak, and lump power, to meet needs. If this vanishes, they would be hurt.

TITANIUM INDUSTRY

(a) Production at Henderson plant, tonnage, costs.
(b) Lockheed Aircraft Corp. requirements.
(c) Douglas Aircraft Co., Inc., requirements.
(d) Rohr Aircraft Corp. requirements.
(e) Boeing Airplane Co., Seattle (L. M. Hitchcock).
(f) North American Aviation Co. (L. P. Spaulding).
(g) Bureau of Mines, Boulder City station.

Senator Malone

(a) Several other important materials that must have power to be produced are required in the reduction of titanium.

Reviews need of power, especially for the titanium industry.

Some witnesses will not be heard, but will submit briefs after a titanium survey by the aircraft industry and the Government has been completed.

Roy A. Watkins, chairman of Titanium Committee, Aircraft Product Resources, Wright Patterson Air Force Base

Titanium is the most important metal in industry today.

Sent to Nevada to see about more power and the outlook.

Considerably less titanium is in finished parts than the metal used to make them. Manufacturers and the Air Force seek to learn the quantity of metal that must be produced.

Briefs of findings will be submitted to the Public Works Committee.

(a) More than 50 percent of the titanium is lost as waste from the spone form to the finished sheets.

Bureau of Mines is working to find a way to reclaim a part of this waste.

Only one quarter of the weight of the sponge titanium now finds its
(a) way into the finished airplane part.

Such information as he has indicates they are short of titanium in Ordnance, Navy, and Air Force.

(a) Twenty kilowatt-hours are required to produce 1 pound of titanium sponge metal. Therefore 4 billion kilowatt-hours will make 100,000 pounds of sponge. Out of this only 25,000 pounds will be in airplanes as flight weight. The remainder is waste.

Battle Institute has three projects going on how to save titanium scrap.

The Bureau of Mines has done most; developed the Knoll process.

Twenty-five thousand fabricated tons is a very small amount.

Stauffer Chemical Co., United States Lime Co., Combined Metals Reduction Co., Western Electrochemical Co. at Henderson, each make products used in producing titanium by Titanium Corporation of America. They all use large quantities of electric power. Together they make a unit operation, the only one in the world.

They only import rutile (ore of titanium), about 75 percent from Australia, 25 percent from Florida, smaller amounts from other sources. Rutile and illmanite are the two principal ores, found extensively throughout the world. We have the largest deposits, Russia the next largest.

The $5 million for exploration we have can develop very much ore in this country.

Strange 75 percent of the ore is imported from Australia when we have deposits here that when developed could be mined cheaper.

Is fourth most plentiful metal in the earth's surface.

(a) We should have self-sufficient production in the United States—certainly in the Western Hemisphere.

Russia is producing titanium. They secured data from Germany, all records after World War II. Japan is now offering for sale in the United States through the Nippon Titanium Co., some very good sponge They should be able to sell cheaper because of their cheap labor.

Only 2 sponge manufacturers in United States, 1 at Henderson, the other du Ponts in the East. Du Ponts have much waste. The Henderson plant is the only one that produces sponge without waste.

At present Titanium Metals Corp. at Henderson makes ingots which are then "scalped" or cleaned off and shipped to Waterville, N. Y., where it is rolled or drawn, and then shipped back to the west coast to be fabricated—much extra freight cost. If Henderson had power, rolling mills could be built there, and finished sheets be dropped down to the aircraft plants in Los Angeles.

Aircraft factories could be built in Nevada near Henderson, plenty of land. Present southern California sites are often in trouble with the residential districts.

People in Fallon and Las Vegas with big airports and factories do not complain about anything. There industries would do well to come here.,

Expansion of the titanium could not be justified unless the necessary power is obtained.

The Government could not consider a contract, but would have to go elsewhere. National security would demand full power to reach a peak in 5 years, for maximum amount of titanium. Rollin Smith, manager, told both Senators Malone and Watkins they would have to move elsewhere if additional power is not available.

Present titanium contracts are not being filled. Without more power Nevada might lose the industry. Power in sight from Arizona and California would be temporary.

The military demand is almost unbelievable; it is wanted for ordnance, for airborne tanks, for nonmagnetic submarines, snorkel tubes, etc., and for armorplate. It is 40 percent lighter than steel.

In commercial industry, automobile fenders and accessories would never rust and be much lighter. It is acid and rust resistant. Many utensils and containers made of it would not have to be plated or lined. Artificial legs, arms, etc., are in great demand. In surgery, a piece of it in the blood stream produces no infection. No end of commercial and medical uses, but it is a "war baby" now and they can't get it.

Henderson, Nev., is the ideal site. The old magnesium plant is ready for use and will save millions.

Gen. Kern Metzger writes, "The future progress in aircraft development after 1956 is believed dependent upon the availability of proper metals."

Describes utility of titanium in planes flying at supersonic speeds.

Titanium will reduce needs for other critical metals, such as nickel and tin, or divert them to other urgent uses.

Properties and uses of titanium.

Fuel consumption in jet planes is enormous, weight saved means more mileage.

Rex Lloyd, Chief, Boulder City Station, United States Bureau of Mines

(g) At Boulder City Station they are familiar with titanium production methods up to sponge metal. Fabrication work is done at College Park Station, Bureau of Mines.

Details history of titanium by the Bureau of Mines.

An arbitrary price of $5 per pound for titanium sponge was set by du Pont and Titanium Metals. Doubtful if either has made any money at that price yet, as much is spent in developing and improving the process.

Bureau's objective is to cut down the cost.

They have brought cost down to $3.26 a pound for sponge metal.

They buy their titanium tetrachloride. Cost might be lower if they made it.

Both du Pont and Titanium Metals now make their own tetrachloride, but in relatively small quantity.

Bureau believes that using the Kroll process, as soon as "bumps" are ironed out, should produce sponge for about $2 per pound, perhaps $2.50, in that range.

(g) Price could come down if it was not necessary to spend so much money in efforts to develop a better process. They hesitate to build big new plants with present limited know-how. Processes on paper indicate that a process can be put into operation to produce titanium at a much cheaper price. The Bureau is not yet convinced that this is so, but understands reluctance of manufacturers to spend large sums on a process when a cheaper process may be "just around the corner."

There is a provision in Titanium Metals Corp. contract to cover expense of converting to a new process if becomes necessary.

Titanium situation complicated by the Government trying to push normal development into a very short time.

Titanium may not compete with aluminum in cost, but it will compete with stainless steel. It is about 60 percent as heavy as stainless, has the strength of the best stainless and in alloyed forms it has strength well above that of stainless steel.

(g) Doing work to increase the uniformity of the metal, and low in hardness.

It took many years to be able to turn stainless-steel scrap back into the furnace but it is done now. They are working toward that now with titanium.

Even if the price is brought down to $1 per pound it will mean but little if the cost of melting and fabricating stays as high as it is now.

It is an important metal but there is much to be done in its technology yet.

Rollin Smith, general manager, Titanium Metals Corporation of America

Henderson titanium operation is the largest fully integrated plant for producing titanium in the world.

Present program calls for 10 tons per day; and requires 15 kilowatt-hours per pound.

Now negotiating for 150-percent expansion, on their 10-ton-per-day unit. Contemplate ultimate expansion to use 450 million kilowatt-hours per year.

Rex Lloyd (*continued*)

Titanium Metals Corp. put plant at Henderson, one reason being that the old magnesium plant could be used. They had their chlorinators, magnesium cells especially suitable to the Kroll process. The setup was a "natural." Whether they can remain depends upon a greater permanent supply of electric power.

The low humidity at Henderson is advantageous to the Kroll process. Do not know how much money or cost it saves, but the people who work with it like a dry climate. Humidity must be removed before melting.

F. T. Wood, Jr., materials and process engineer, Douglas Aircraft, Inc.

Quantities and schedules of delivery of military planes are classified.

In the DC–7 airplane they plan to use 330 pounds of titanium per airplane.

Will need about 29,000 pounds of titanium in the next 2 years. Have been buying, have some on hand.

High price and lack of uniformity makes use slow. If price comes down and better fabricating technics developed they could use up to 9 to 12 percent of airframe weight. In a DC–6 the airframe weight is from 20,000 to 22,000 pounds.

They think a pound of weight saved is worth about $20.

Douglas Co. thinks of making an air transport plane, so are Lockheed and Boeing.

In DC–7 airplane, weight of titanium will be only 1.6 percent of airframe weight. The 9 to 12 percent weight is based on future alloys not available to them in quantity now—1.6 percent will amount to 330 pounds, they will buy 500 pounds to get 330 pounds.

With aluminum at 40 cents and stainless from 60 cents to $1 a pound, it is a long time before much titanium will be used at the present high cost.

Airplane or airframe weight is about 25 percent of the total gross weight of an airplane.

Suggests contact with the Aircraft Industry Association for figures on anticipated production and uses. They are conducting a general survey that should be completed in 4 or 5 weeks. Should give good idea of use for next 5 years.

A good service record for titanium will also be necessary.

F. E. McCreery, executive chief engineer, Rohr Aircraft Corp.

(*d*) Rohr Corp. is a subcontractor, and its requirements are designated by the contractors. They are manufacturing and designing powerplants (engines) for Douglas, Lockheed, Boeing, Chase, and others.

Presently committed to aroung 40,000 pounds of titanium for one of the larger bombers.

Their rate will be about 8,000 per month for year 1953.

Rohr is running twice the tonnage of stainless steel compared to aluminum for engine manufacture, for which they are going to be able to use titanium.

Half of the stainless they use could favorably be changed to titanium alloy. The two main concerns they have is to bring the cost down, and to secure consistency of the metal, which cause a lot of trouble just now.

Within a year the strength, ductibility, and fabrication methods should greatly improve.

For supersonic aircraft there are stainless steels that will do a better job than titanium.

(*d*) Titanium has the possibility of replacing one-half of the stainless steel being used today, for weight saving.

It will not fully replace stainless steel. Some stainless steels are stronger than titanium.

Where there is fuming nitric acid and corrosion problems, in connection with strength ratios, the titanium takes precedence.

Alloyed titaniums are still in the background, there is yet a lot of work to be done on them.

Their developments are with the commercially pure titanium.

Has made a rough calculation that 1,000 tons a year will be needed on the powerplants (motors) for present contract for 5 or 6 of the major contractors of the Nation, in Rohr plant alone.

Titanium will have a wonderful application in ordnance, especially airborne equipment, because of weight reduction. It has a wonderful future, both in military and commercial fields.

Technical information regarding the strength of both stainless and titanium at high temperatures.

(*d*) Titanium is limited to about 700° in service. There are stainless steels that stand up under higher temperatures, up to 1500 to 1600°. Below the 1000° mark titanium is good. Titanium is wonderful, does not need any boosting. It will not do all jobs, they will use aluminum, magnesium and stainless also.

Tom Lamphier, vice president of Consolidated Lockheed Corp.

(*b*) They make bombers and fighter planes for the Air Force and Navy and missiles for both services. Also make commercial airplanes.

Can't afford titanium in commercial airplanes, so do not at present use it.

They are a party to surveys being made on titanium.

Must know availability well in advance to plan it in designs.

All aircraft manufacturers could use titanium as soon as it is available and if it costs less. The price is important whether the Government or Lockheed pays it.

They intend to use it to a considerable extent in future military programs.

(*b*) A substantial increase in production (of titanium) is necessary for their present program.

The Air Force cannot say with ease of mind if they can pay current prices for titanium unless supported strongly by the Congress

They will submit a brief giving their best estimate as to their requirements, both for military and commercially, separately.

Rex Lloyd (continued)

(*g*) The Bureau of Mines is normally concerned with conservation of natural resources. They began work with titanium with the thought that its use would replace and save nickel.

Power requirements for a fully integrated titanium plant such as Titanium Metals Corp. is about 17 kilowatt-hours per pound.

They are seeking to avoid the use of big retorts of stainless steel in the Kroll process as that stainless contains nickel which they want to save.

To get needed titanium now a high price must be set. No one can say now that in 4 years or so the price will be $5 or $1. Someone is surely going to come up with a better process than we have now.

Senator Malone

Says improvements in titanium production are bound to come. Cites the case of the metal zirconium and the improved metallurgy developed by Ralston.

Rex Lloyd

Serious work being done on titanium. Support needed until the technology begins to show results. Power is important.

M. G. Mastin, engineer in charge of titanium production, United States Bureau of Mines, Boulder City station

(*g*) Reviews in detail the facts about titanium production and costs by the Kroll process.

A 10-ton plant will run at the most economic rate, utilize a crew to best advantage.

Power cost is a very small part of the total cost, but if power is not available they cannot operate here at any price.

Raw material costs are also small, only about 18 cents per pound of titanium.

Thinks the cost of titanium could be brought down below the $2 figure in time. Chances are for a new process to be developed within a reasonable time, since several hundred expert technologists are doing nothing now but work on titanium.

In Mastin's opinion the cost of fabricated titanium will come down where it will be in competition with stainless steel.

Titanium tetrachloride should not be handled in a heavily populated area. When liberated it would drive everybody out. It has been used as smoke screen by the Navy.

Titanium is here to stay, and the market will increase.

Southern Nevada best location for several reasons, one being the dry climate. In the East the whole plant would have to be more or less dehumidified.

Confirms testimony of McCreery—titanium will not do everything, will not fill all purposes, yet it has so many good properties that it is the coming metal of today.

Roy A. Watkins

NPA granted a $14,700,000 loan to du Pont Co. to expand its present titanium facility. The agreement included a clause whereby if for any reason the plant becomes obsolete within the next few years the Government will buy it back. That is only to replace the Kroll system. We had to do that in order to get sponge metal production.

Du Pont is protected on any inventions or new processes.

Standardization of sheets and forms would save much money. The forms should be stockpiled in standard sizes of pure metal.

Much titanium sponge has been spoiled by humidity, but not in Nevada.

We must go ahead with the present Kroll process, because any new process could not get into production; under present conditions in less than 2 years. We cannot afford to wait that long.

Government figures show that present production will not supply one-eighth of the titanium required.

A release from Defense Production Administration shows the goal for supply of rutile (ore of titanium) is 25,000 tons.

About two-thirds of our present supply of rutile is imported from Australia; the other one-third is domestic.

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